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Forest Resources of the World

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EDITOR'S NOTE

One of the great problems of international forestry has been ascertaining the world's forest resources. This was one of the most urgent tasks allotted the Forestry and Forest Products Division of FAO by the First Session of the FAO Conference held at Quebec in 1945. Less than a year later, the Division published an interim report entitled *Forestry and Forest Products — World Situation 1937-1946,* which summarized all existing data on this subject.

This was only the first step. If work in this field is to be useful, it must be based on authentic reports by governments, and it must be continuous in order to follow an ever-changing picture.

A forest inventory questionnaire was therefore sent out to all governments in the summer of 1947 in order to obtain new and up-to-date information. The establishment of this questionnaire was difficult because the questions had to be applicable to all parts of the world and to a very wide variety of forestry and administrative conditions. The answers to this first questionnaire have now been assembled and are reproduced in this issue as a report on the forest resources of the world. It is as up to date and accurate as generous and painstaking government co-operation could make it. It is unique in that it presents data a few months after receipt; usually, several years elapse before the data collected can be put into book form or published as statistical compendia.

The making of forest inventories presents a number of problems, especially in countries with large undeveloped forest areas. A new tool coming into wide favor for carrying out inventories of forest resources is aerial photography. An article by Stephen H. Spurr, Assistant Professor, Harvard Forest, Harvard University, on methods and possibilities is therefore included in this issue.

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The Three Programs of FAO

By NORRIS E. DODD

Director-General of the Food and Agriculture Organization of the United Nations

THE longer I live, the more I have come to realize that our human problems are indivisible. This is particularly the case with FAO where land, sea, and air have their contributions to make to feeding, clothing, and housing a multiplying population. Sunshine and rain, the natural and cultivated fertility of the soil, the produce of the sea, all condition the range of our activities.

Our forests—a mere fraction of their once vast acreage, and, indeed, a fraction of what they may again become—are an essential item in the over-all problem of meeting human needs. It was no accident that brought forestry within FAO's far-reaching scope. Forestry is an essential part of our work and a vital contributing factor to our plans for raising existing standards of living and providing the future food supplies which an expanding and hungry humanity will require.

In our FAO policies we always have three programs: the program for the immediate future, the program for the next five years, the program for the next hundred years. We must help to solve the immediate shortages of food, clothes, and homes. We must help nations to plan their activities over the next five years so that rising standards of living are achieved and full co-operation established between one nation and another in a common cause. We must peer deep into the future, with the best assistance and advice we can provide, so that coming generations will derive an enduring benefit from our long-term plans and programs.

Our forestry policy, under the wise guidance of Mr. Leloup, is covering all three fields. One of the immediate problems of today is Europe's shortage of timber. Our Forestry and Forest Products Division, through the FAO/ECE Timber Committee, is working out plans to secure increased supplies of wood products now and in the coming year

so that houses and resources may be available for Europe's homeless thousands. Economies in immediate consumption and fair distribution of available supplies are factors which are being applied to this end.

But in Europe, obsessed as it is by its immediate problems, we are not limiting our activities and plans to the near future. Through the regional Forestry and Forest Products Commission we are taking a longer view into the future and aiming at the co-ordination of European forestry programs and practices so as to ensure that forestry plays its full part as a conserver of our natural food-producing resources as well as a supplier of timber.

This activity is not limited to Europe. The Teresopolis Conference has prepared the ground for similar activities in Latin America.

Similar plans are being developed for the Middle East and also for Asia and the Far East.

GRADUALLY we shall cover the globe in our planning of a long-term forestry program and the effective development of timber supplies to meet humanity's needs. It may be true, as William Vogt says in *Road to Survival,* that we must tighten our belts in the immediate future in order that the long-term requirements of an expanding world population are not prejudiced. Certainly forestry has much to offer the world, if wisely directed, as an insurance against future catastrophe. It can play a great part in counteracting some of the improvident practices which, over the last decades and centuries, have reduced our natural resources and so endangered future food supplies. FAO's policy in this field is to advise and assist in all such long-term conservation policies and at the same time to ensure that the best possible use is made of such timber supplies as can be made available without endangering our longer-term projects.

N. E. Dodd

RESPONSE TO FOREST INVENTORY, 1947
Reporting Countries
Partial Reports
FAO Chart No. 211
ALASKA
CANADA
UNITED STATES
U. S. S. R.
BRITISH ISLES
TURKEY
CHINA
JAPAN
INDIA AND PAKISTAN
ALGERIA
EGYPT
ETHIOPIA
PHILIPPINE ISLANDS
VENEZUELA
COLOMBIA
BRAZIL
BOLIVIA
AUSTRALIA
NEW ZEALAND
EQUATOR

Forest Resources of the World

THE whole world is suffering from shortages of forest products. In some regions the deficits are of long standing; in others, they date from the outbreak of the Second World War. Everywhere they retard progress toward greater prosperity and improved standards of living. Are the forests of the world inherently capable of yielding more bountiful supplies of their products in the years to come, or must man forever resign himself to the present situation?

From the earliest times to the present day the greater part of the world's people have relied on the forests for their fuel. Timber has always been one of the most important building materials. The modern industrial age brought with it new demands for wood for direct use in manufacturing industries and for making the crates and boxes which protect their products in transit. Phenomenal developments in the use of wood pulp during the past century have made the forests the primary source of most of the world's paper and of a substantial proportion of its textiles. Wood chemistry is constantly developing entirely new products derived from wood. Thus, the need for products of the forest has increased rather than decreased with each advance of civilization.

The forest is a renewable resource, but it is also destructible. Given skillful management, it can yield annual crops of wood in perpetuity; but, if the rate of exploitation is allowed to become too high, destruction of the resource itself may follow. Uncontrolled exploitation, carried out with no thought for the future or regeneration of the growing stock, still continues to reduce the forest areas of the world.

The situation would be less serious if unwise harvesting of forest products were the only source of devastation. Unfortunately, there are many others. Misguided removal of forests from true forest soils in order to make room for poor and unproductive farms still continues; in the tropics, vast areas of forests have been degraded or destroyed by the cycle of shifting cultivation; excessive grazing by livestock has all but eliminated the last vestiges of forest cover in some regions; repeated fires have reduced former forest areas to barren wastes; and disturbance by man of the delicately adjusted balance of natural forces within the forest has often set the stage for disastrous outbreaks of injurious insects and tree diseases.

If the volume of standing timber in existence today constituted the sole resource for the future, the forests of the world would probably be destroyed within a few decades. But the ability of forests to reproduce themselves and to grow tends to offset the destructive forces and makes possible the harvesting of recurrent crops of wood from any area of productive forest land. Hence, in a study of the forest resources of the world, determination of the extent of productive areas and, above all, determination of the rates at which they can produce wood in perpetuity are far more important than the estimation of present volumes of standing timber. Yet estimates of volume are necessary as a guide to present policy and as a basis for future comparison.

In many localities the lack of forests, as such, is even more serious than the shortage of their products. Important regions that once supported large populations and highly developed civilizations have been transformed into desert wastes by the forces of soil erosion which, in their turn, were unleashed by the reckless destruction of protective forest cover. Extreme examples can be found in the Middle East, but different stages of the same disastrous progression are to be seen in many other lands.

Forests must be maintained to protect watersheds and drainage basins, to regulate stream flow and prevent erosion, and to protect agriculture itself. These protective values of the forest are local in their effects, and cannot easily be summarized in regional or global terms. Nevertheless, the necessity for maintaining certain forests primarily for protective purposes, together with the increasing social desire to reserve still others for recreational use, are factors affecting world supplies of wood.

Since an adequate supply of wood is essential to the well-being of any community, regardless of its stage of industrial or cultural development, the current world-wide shortages of forest products and local shortages of forests give rise to questions of far-reaching significance. Although some shortages have been accentuated by the dislocations of war, their underlying causes may be of a more permanent nature. Three factors, namely, the rapid rate of increase of the world's population, the universal desire to improve living standards, and new technical developments, foreshadow increased demands. The urgency of the question as to whether or not the world's forest resources are sufficient in extent and in productive ability to sustain present and prospective needs for their products is increased by the fact that overexploitation inevitably leads to devastation. Once the forest is destroyed it can be restored only at great expense, and, under some conditions, reestablishment may be impossible. These facts amply demonstrate the importance of an accurate assessment of the world's forests and of the volume of production which can reasonably be expected from them.

Former Estimates of Forest Resources

The first comprehensive attempt to estimate the forest resources of the world was made by Dr. Raphael Zon and Mr. William A. Sparhawk of the United States of America immediately after the First

World War. The results of their inquiry were published in 1922 and served as a standard source of reference throughout the interwar period. Professors Ilvesallo and Jalava of Finland made further investigations in 1928, and in 1931 Professor Thorsten Streyffert of Sweden published an important study of the coniferous (softwood) resources of the world. The next step was taken by the International Institute of Agriculture at Rome, which published estimates supplied by national governments in a series of yearbooks which appeared from 1933 to 1938. In 1946, available information respecting the forests was summarized in a report submitted to the Second Session of the Conference of FAO under the title *Forestry and Forest Products — World Situation, 1937-1946*. In the same year Sir Hugh Watson of Great Britain made an independent study which appeared in the [British] *Empire Forestry Handbook*.

All these investigations made valuable additions to our knowledge, but all suffered from certain fundamental difficulties. Most important of these were the lack of reliable forest inventory information, which existed and still exists in many countries, and the lack of commonly accepted definitions of some of the more important forestry terms. Hence, to the weakness of some of the quantitative estimates there was added doubt as to the real meanings of some of the qualitative descriptions.

The question of forestry definitions was considered by a joint committee appointed by the International Institute of Agriculture and the International Institute of Statistics. The committee's report was published in the proceedings of the IIS in 1936. Its findings do not appear to have received any considerable measure of international acceptance, and it has become evident that a comprehensive inventory of the world's forests requires a truly international approach, entailing international acceptance of definitions as well as concerted and sustained efforts to encourage completion of adequate surveys of those forested areas for which reliable data are lacking. The organization and promotion of this important task has been entrusted to the Forestry and Forest Products Division of FAO.

Preparations for the Forest Inventory, 1947

At the First Session of the Conference of FAO, in the autumn of 1945, the need for up-to-date information respecting the forest resources of the world was fully recognized, and it was recommended that an inventory should be undertaken as soon as possible. In May 1946 the Forestry and Forest Products Division of the Organization came into existence, and work was immediately commenced on the report on the world situation previously mentioned. Statistics regarding forests and forest products were summarized and a thorough discussion of conditions as they then appeared was presented. Recognizing that most of the forest statistics then available were incomplete and out of date, the Second Session of the Conference recommended that

> "All countries should be requested to supply to FAO as soon as possible their most recent statistics on forest resources, annual growth, annual drain, and forest products."

In accordance with the recommendation of the Conference, a draft forest inventory questionnaire was prepared by the Division. Only those questions which are essential to an appraisal of the forestry situation in each country were included, and a special effort was made to avoid questions which many countries could not reasonably be expected to answer. Explanatory notes were provided with each question. Selection of the questions and definition of their meanings were difficult because, from the nature of the undertaking, they had to be applicable insofar as possible to all parts of the world and to a very wide variety of forestry and administrative conditions.

The inquiry was deliberately restricted to areas now bearing forests and areas recently clear-cut or burned but which will be reforested promptly. It was recognized that there are, in many lands, large areas of denuded soils which ought to be reforested as soon as possible for reasons of production or protection. The future progress of reforestation in individual countries, however, must depend so largely upon public policy, general economic conditions, competition of other activities such as grazing, and financial considerations that it seemed impossible to write and define questions for universal application which could be relied on to secure information on this subject more conclusive than the personal opinions of the respondents.

While preparing the draft questionnaire, the Division had the benefit of advice from the Economics, Marketing, and Statistics Division of the Organization. Later, the draft was submitted to the criticism of two special international conferences on forest statistics. The first of these met at Washington in February 1947 and was attended by representatives of fifteen countries of North and South America, the Far East, and Oceania, and by a representative of the Caribbean Commission. The second meeting was held in Rome at the end of March and was attended by representatives of thirteen countries of Europe and the Middle East and by the secretary of the Timber Subcommittee of the Emergency Economic Committee for Europe. These two conferences approved the general arrangement of the questionnaire, but proposed certain amendments which were subsequently incorporated in the printed document. Finally, the questionnaire was submitted to, and approved by, the Third Session of the Conference of FAO in August 1947. Thus the form as finally issued had received a wide measure of international approval.

Copies were prepared in English, French, and Spanish and sent to the governments of all countries by the Director-General of FAO with a request that they should be completed and returned to Washington by 31 December 1947. Although a number of countries are not yet in a position to answer all the questions asked, and some have not replied, it is hoped that all will accept the outline included in the FAO questionnaire as the basic minimum schedule of information which should be provided for in any national scheme for a forest survey and inventory. Many countries will build up a far greater degree of detail on this foundation, and some have already done so.

It is intended that the forest inventory investigation should be repeated periodically in the future. This procedure will make it possible to show changes in the forestry situations of those countries which already have reasonably reliable forest inventory

data. For other countries, where information respecting the forest resources is now inadequate, future questionnaires will show the progress made in obtaining new knowledge.

No final decision has been made as to the date of the next world-wide inquiry. It is known that a considerable amount of survey work is being conducted and that valuable data respecting the small forests incorporated within the boundaries of farms are likely to be collected in connection with the World Census of Agriculture in 1950. Possibly progress in these directions will justify a second inventory inquiry by FAO in 1952.

On the whole, the questionnaire used in the present inquiry has served its purpose well. It is evident, however, that some revision will be desirable before the inquiry is repeated, and FAO will welcome and most carefully consider suggestions for improvements.

Some Definitions

One of the most difficult problems encountered in a world-wide study such as the present one arises from differences in meanings assigned to specific terms in different regions. These difficulties are increased by the necessity for translating each term into several languages. For example, it has been found that in one country the term "forest inventory" may include forest areas, timber volumes, and annual growth, while in another it may be used in a more limited sense and refer solely to the measurement of standing timber. As used by FAO, the term "forest inventory" includes information regarding the extent and classification of forest areas, the distribution of different forms of forest ownership, estimates of volumes of standing timber, and comparisons of annual growth in the forest with annual drain due to natural causes and fellings.

Some confusion exists because of variations in local usages of the terms "softwoods" and "hardwoods." In this case differences may be found not only between countries but even between localities within a single country. Sometimes the word "softwood" is considered to embrace wood from all coniferous species, even though some conifers may be harder physically than certain woods taken from broadleaved species. Elsewhere, "softwood" means all conifers and, in addition, the woods of certain broadleaved species which are physically soft, e.g., poplars and willows. In the English language FAO uses the terms "Conifers (softwoods)" and "Broadleaved species (hardwoods)" as defined below:

> *Conifers (softwoods)* — All trees classified botanically as Gymnospermae (e.g., pine—*Pinus*, fir—*Abies*, spruce—*Picea*, larch—*Larix*, Parana pine—*Araucaria*, and ginkgo—*Ginkgo*) have been included in this category.
>
> *Broadleaved species (hardwoods)* — All trees classified botanically as Angiospermae. The species belonging to this group are generally broadleaved (e.g., oak—*Quercus*, beech—*Fagus*, maple—*Acer*, lignum vitae—*Guiaicum*, ebony—*Diospyros*, balsa—*Ochroma*, and poplar—*Populus*).

No forestry terms have been used more loosely than "growth" (or "increment") and "yield." Yet, in international forestry statistics, none so urgently require explicit definition. In the forest inventory questionnaire, use of the term "yield" was deliberately avoided in order to eliminate one possible source of confusion. Nevertheless, it may be well to set down the meanings assigned to it by this Division. The important point is that the words "growth" and "yield" are not synonymous. "Growth" is a function of trees and forests; "yield" is a measure of the output of forest products.

> *Yield* — The quantity of products taken from the forest.
>
> *Sustained yield* — Annual or periodic output of a constant volume of products in perpetuity. (Sustained yield is only possible if sustained growth is maintained within the forest.)
>
> *Potential yield* (of an undeveloped forest)— The estimated volume of products which might be obtained annually if the forest were managed in accordance with sustained yield principles.

The terms "overexploitation" and "underexploitation" are also subject to various interpretations. In this report "overexploitation" is considered to exist when the forests are being felled at a rate too high to be sustained indefinitely. If the distribution of age-classes in the forest is normal, the rate of fellings may correctly approximate the rate of net growth; but if younger age-classes predominate, a rate of felling considerably lower than the growth rate may be all that is justified at present. "Underexploitation" means that the rate of fellings could safely be increased.

Principal Elements of the Inventory

The information which should be provided by any national forest inventory, regardless of the amount of detail which may be desired, may be grouped under five main headings. These are concerned with forest areas in relation to other classifications of land, classification of productive forests, forms of forest ownership, volumes of standing timber, and the relationship between annual growth and annual drain. Each of them is covered by a separate table of questions in FAO's questionnaire. In order that the considerations governing the selection of specific questions may properly be understood, each heading is discussed separately hereunder. Definitions relating to individual questions immediately precede the detailed tables (Tables 4-10).

Land Classification

The first step in describing the forest resources of a country must be the determination of total forest area. Until the area is known with at least approximate accuracy, formulation of a national forest policy is virtually impossible. However, an estimate of the total area on which the dominant vegetation is composed of trees is not sufficient, because not all forests are susceptible to management on a sustained yield basis. Two broad general classes must be recognized, namely, "productive forests" and "other forests." It is the productive forests upon which reliance for the wood supplies of the future must be placed. The "other" forests comprise areas which bear a greater or lesser degree of tree cover, but where site

conditions are so unfavorable that the trees are of very slow growth and of dwarfed and stunted form. Forests of this kind occupy vast areas near the southern margins of the treeless tundras or "cold deserts" of the far north and in the arid savannah formations fringing the "hot deserts" of Africa. Others are to be found at high altitudes near the upper limits of tree growth and on poorly drained sites of high acidity. Some of the last-mentioned group may eventually be transformed into productive forests by drainage, but it is highly improbable that the other groups will ever be able to provide forest products other than small and irregular supplies of fuelwood. In some continents the total forested area (meaning the whole area bearing tree cover) is useless as an indication of potential forest productivity because of the preponderance of areas which properly fall into the nonproductive category just described.

In order to appreciate the relative importance of forests within a country, it is necessary to know the areas of cultivated lands and grasslands and of other lands which are not being used for any productive purpose. It is also necessary to know how many people the forests may be called upon to serve. Population figures used in this report were obtained from official sources other than the forest inventory questionnaires.

Classification of Productive Forests

Division of the productive forest into accessible and inaccessible areas is needed as a general guide to forest policy, because the former class provides all of the current supply of forest products while the latter constitutes the potential reserve which may be developed in future. Nevertheless, the classification itself is relative rather than absolute. Many different degrees of accessibility exist, and the status of any particular forest may change suddenly because of the introduction of new technical devices or because of changes in the prices obtainable for forest products. Within a given country accessibility may be influenced quite as much by the distribution of the population and the degree of development of transportation systems (roads, railroads, etc.) as it is by topographical and other physical conditions in the forest. It is to be expected that most of the areas now classed as inaccessible will eventually be opened up for exploitation, although some are surrounded by physical conditions so difficult that it may never be economically possible to harvest and transport their products.

Subdivision of the productive forests into their component areas of coniferous, broadleaved, and mixedwood types is essential because of the differences between the demands for coniferous and broadleaved woods. Some of the tropical broadleaved forests provide the most valuable species of wood known to commerce, and both in the tropical and temperate zones broadleaved trees are the principal sources of fuelwood. However, more than 70 percent of the wood used for construction, packaging, the manufacture of wood pulp, and other industrial purposes is provided by the coniferous species.

Forest Ownership

Information respecting the distribution of different forms of ownership of productive forest lands helps to determine the kind and extent of the problems likely to be encountered if more intensive forest management is to be introduced on a nation-wide basis. For example, methods of administration and forest regulation entirely suitable for large forest areas under public ownership might be quite impracticable in another region where the individual forests are small in area and privately owned.

Volume of Growing Stock

Among those countries in which the practice of systematic forestry has reached a high stage of development, and where statistics relating to forest resources may in general be classed as good, there is great diversity in the completeness and detail of statistics relating to the volume of standing timber. In some countries estimates of volume are considered to be of cardinal importance; in others, where annual yields per hectare have been established on the basis of long experience, less attention has been paid to estimates of volumes as such.

It is to be hoped that estimates of volume will be improved in future, for several reasons. Direct comparison of volume estimates taken at the beginning and end of a period of years provides the most reliable check on the results obtained from current forest management policies. Such comparisons have been known to yield results quite different from those which had been predicted on the basis of direct measurement of annual growth, and have furnished timely warnings leading to the introduction of revised policies. Some modern thought seems to be tending toward the view that maximum yields per hectare depend on the maintenance of relatively large volumes of growing stock, because "wood grows only on wood." Here again better statistics of volume seem to be indicated.

It is quite possible for a nation to show a favorable balance between total growth and total drain in the forest while deterioration in the quality and kinds of wood available is steadily progressing. Reports received by FAO indicate that this has actually occurred in certain countries. Hence, it is important that periodic inventories of growing stock should show separately the volumes of conifers and of broadleaved species, and that these volumes should be further subdivided to show the amounts of wood contained in trees large enough to be acceptable for sawing into lumber and in trees of smaller dimensions.

In some countries estimates of standing timber show the total volumes in all trees, including the wood which will be left in stumps and tops. In others, it is the practice to exclude volumes contained in stumps of a given height and in the tops of trees above a selected minimum diameter of the bole. In the case of broadleaved species some countries include volumes of branchwood in their estimates and some do not. These differences in established practices introduce certain incongruities when total volumes of standing timber are compared from country to country. In themselves, these differences are not considered to be particularly significant, but it is most desirable that estimates of annual growth and drain in each country should be computed on the same basis as the volumes of standing timber.

Annual Growth and Annual Drain

A comparison of the rate at which wood is produced in the forest and the rates at which it is destroyed by natural causes and removed by man should be the most important feature of any forest inventory. It may show that the forests are being felled too heavily or that the wood they grow is not being fully utilized. If overexploitation persists, destruction of the forest and loss of future production will follow. On the other hand, underexploitation indicates failure to make full use of the productive power of the forest soil. Since it is recognized that attainment of the highest degree of well-being lying within the reach of any society depends upon wise use of all the natural resources at its disposal, overexploitation or underexploitation of the forests presents problems of major importance demanding the attention of public authorities and of the people at large.

To recognize the importance of a comparison of growth and drain is easy; but to secure the information for making it may be extremely difficult. Measurement of forest growth is a complex undertaking requiring a high degree of technical skill and the correct application of suitable methods of statistical analysis. Measurement of losses due to natural causes is almost equally difficult, and satisfactory estimates of quantities felled must depend on adequate arrangements for the collection of national production statistics within the country concerned. Fluctuations in climatic and business cycles make short-term averages unreliable; hence, average rates of growth and drain should be computed for periods of at least ten years.

The matter becomes much more complicated when an attempt is made to secure comparable statistics on growth and drain for a whole continent, because the underlying assumptions on which statistics of this sort must be based may differ from country to country. Thus, regional totals can only be compiled by bringing together national figures which are not likely to be precisely comparable.

Still greater difficulties are met in a comparison of total growth, net increment, and total yield of forest products for the world as a whole. Here the difficulties outlined in the previous paragraph are multiplied because of differences in the nature of the forests of different regions, differences in the distribution of population and in consumption habits, and differences in the degree of development of scientific forest management. Indeed, these differences are so great as to affect the meanings which can be assigned to some commonly used forestry terms. Furthermore, comparison of figures representing annual growth and annual fellings may or may not lead to a correct determination of the actual forestry situation within a country or region, because of local differences within a single country. For these reasons it is considered to be impossible, in the present state of our knowledge, to compile truly comparable regional estimates of growth and drain which in turn could be combined in world totals. Instead, we are forced to rely on approximate estimates of the quantities of wood which the forests of the world *might* yield if all of them were given a reasonable measure of management according to correct forestry principles.

Even though they cannot be combined in world totals, estimates of the growth-drain situations in individual countries are of great interest. In this case formulation of a series of questions which could be interpreted and answered in all regions with a reasonable degree of consistency presented problems of considerable difficulty. It was decided to ask each national authority to state the total volume of annual growth within its forests, treating conifers and broadleaved species separately if possible, and to subtract the volumes of natural losses caused by fire, insects, and tree diseases in order to obtain figures representing net growth. The annual volume of fellings was then to be subtracted from net growth, the result being a positive or negative balancing item which, within the limits indicated above, should give some indication as to whether the forests have been overexploited or not. These calculations were confined to forests classified as productive and accessible. In addition, an approximate estimate of total growth in the inaccessible forest, regardless of offsetting natural losses, was requested in order to obtain an approximate idea of the yields which may be secured in future if and when these forests are opened up and rationally managed.

Tables 8, 9, and 10, which present the results of this part of the inquiry, should be read in the light of comments presented in the immediately preceding paragraphs.

Response to the Questionnaire

Official statements respecting the forest resources of 101 countries and nonself-governing territories were received up to the date of publication. Additional questionnaires may yet arrive, but widespread interest in the results of the inquiry justifies publication of the information contained in this report without further delay.

The response is summarized in terms of total land area in Table 1. Here and in subsequent tables the information is grouped by continents, except that the U.S.S.R. is treated as a separate unit in order to avoid division of a single national entity between Europe and Asia. Islands of the Caribbean are included under North America. Japan, the Philippines, and the Netherlands Indies are included under Asia, but the eastern half of New Guinea is considered to be part of Oceania.

TABLE 1.—Response to the Inventory Questionnaire

Continent or Country	Total Land Area	Area of Reporting Countries	Percentage Response
	(*Million hectares*)	(*Million hectares*)	(*Percent*)
Europe (excl. U.S.S.R.)	482	332	69
U.S.S.R.	2,255	.....	---
North America	2,347	1,854	79
South America	1,755	1,487	85
Africa	3,060	2,245	73
Asia (excl. U.S.S.R.)	2,591	1,609	62
Oceania	855	802	94
Total	13,345	8,329	62

If the estimated area of Antarctica is included in the calculations, the replies received cover 58 percent of the net land area of the world. On the other hand, because very large areas, such as Greenland and most

of the Arabian peninsula, are practically devoid of forests, the replies cover 66 percent of the total forest area, and about the same proportion of the productive forest area.

As was to be expected, there was a great deal of variation in the completeness with which the questionnaires could be answered. Although all reporting countries provided the information summarized in Table 4, Land Classification, a considerable number were unable to furnish data for one or more of the succeeding tables. Responses, calculated on the basis used in Table 1, were as follows: Table 5, Classification of Productive Forests, 61 percent; Table 6, Ownership, 59 percent; Table 7, Growing Stocks, 47 percent; and Table 8, Growth and Drain, 44 percent. It must be recognized that, whereas the replies from countries in which the practice of forestry is highly developed summarize a great wealth of accurate and detailed knowledge, answers from some other lands rest upon a very narrow basis of exact information. At the present stage of affairs general estimates, prepared by the national authorities in the best position to make them, are unquestionably of great value, but a vast amount of forest surveying remains to be done.

For many countries, and perhaps especially for those that maintain the most complete and detailed records, completion of FAO's questionnaire was not an easy task because of differences between the form and arrangement of national statistics and the standardized outline in the questionnaire. For example, a reappraisal of the forest resources of the United States of America had been completed in great detail shortly before the FAO inquiry was launched, and conformity with the internationally accepted outline in the questionnaire entailed a considerable amount of rearrangement and regrouping of figures in a manner somewhat different from anything that had previously been made public. What was true in the United States applied equally in other cases.

Presentation of the Results

The detailed information relating to individual reporting countries is summarized in Tables 4-10 which appear at the end of this report. These detailed tables are immediately preceded by definitions relating to the headings used. Because complete returns were not received from any continent, no totals appear in these tables.

The detailed tables present the maximum amount of information which it was possible to compile from the inventory questionnaires on a reasonably consistent basis. A certain amount of condensation has been necessary and replies to some of the individual questions do not appear in the tables, partly because of the paucity of replies. A relatively small amount of variation in the interpretations of certain questions also affected final decisions regarding the headings selected for these tables.

Since official reports have not been received from all countries, the forestry situation in each continent cannot be summarized directly from the tabulated data. It is essential, however, to arrive at the closest possible approximation to the correct total estimates for continents and for the world. For this reason the staff of FAO has searched all available records bearing upon the forest resources of countries which have not yet replied, and has prepared tentative estimates for each of them. These estimates were necessarily restricted to forest areas because data relating to forest ownership, growing stocks, and growth in the countries concerned were inadequate. Estimates for individual nonreporting countries are not published, but are included in continental totals for the group.

In Tables 2 and 3 forest areas of the reporting

TABLE 2.—Forested Areas of the World

Continent	Population	Total Land Area	Productive Forests	Other Forests	All Forests: Area	All Forests: Percentage of Total Area	Productive Forest Area per Caput
	(*Millions*)	(*Million hectares*)				(*Percent*)	(*Hectares*)
Europe and U.S.S.R.							
Reporting Countries	278	332	92	6	98	30	0.3
Nonreporting Countries	300	2,405	635	313	948	39	2.1
Estimated Totals	578	2,737	727	319	1,046	38	1.3
North America							
Reporting Countries	167	1,854	465	203	668	36	2.8
Nonreporting Countries	34	493	42	18	60	12	1.2
Estimated Totals	201	2,347	507	221	728	31	2.5
South America							
Reporting Countries	90	1,487	561	78	639	43	6.2
Nonreporting Countries	13	268	103	13	116	43	7.9
Estimated Totals	103	1,755	664	91	755	43	6.4
Africa							
Reporting Countries	138	2,245	290	527	817	36	2.1
Nonreporting Countries	53	815	16	16	32	4	0.3
Estimated Totals	191	3,060	306	543	849	28	1.6
Asia (excl. U.S.S.R.)							
Reporting Countries	990	1,609	264	124	388	24	0.3
Nonreporting Countries	234	982	94	38	132	13	0.4
Estimated Totals	1,224	2,591	358	162	520	20	0.3
Oceania							
Reporting Countries	10	802	24	16	40	5	2.4
Nonreporting Countries	2	53	26	14	40	76	13.0
Estimated Totals	12	855	50	30	80	9	4.2
Estimated Totals (Six Continents)	2,309	13,345	2,612	1,366	3,978	30	1.1
Antarctica	—	1,388	—	—	—	—	—
Grand Total	2,309	14,733	2,612	1,366	3,978	27	1.1

countries, computed from the detailed tables, are combined with estimated totals for the nonreporting countries to obtain estimated totals for each continent and for the world. In preparing the summary statement of distribution of conifers and broadleaved species which appears in Table 3, one half of the mixedwood areas reported in Table 5 was treated as coniferous and the other half as broadleaved.

SUMMARY AND CONCLUSIONS

It is evident that the figures presented in this report do not represent final answers to questions relating to the extent and productivity of the forest resources of individual countries. Incompleteness of returns and the preliminary nature of some of the estimates suffice to show that further inquiries will be needed in future. An even more important obstacle to the preparation of final estimates lies in the nature of the forests themselves, because of their susceptibility to damage, their ability to grow, and the possibilities for extension of their boundaries by artificial means. Nevertheless, and within these limitations, it seems probable that the figures here presented constitute reasonably accurate approximations to the world forestry situation as it now exists. Certain important deductions which can be drawn from them are treated separately hereunder.

Forested Areas

Table 2 shows that the total forested area of the world is estimated to be 3,978 million hectares, of which 2,612 million hectares (66 percent) is classed as productive. Since no less than 1,366 million hectares of forested land are excluded from the productive category, it is evident that the subdivision of total forest area into "productive" and "other" classes was a most important feature of the questionnaire. The "other forests" category accounts for significant proportions of the total forests in all continents, but in Africa it reaches the astonishing proportion of 64 percent of the whole.

Table 3 indicates that the productive forest area is made up of 942 million hectares (36 percent) bearing conifers and 1,670 million hectares (64 percent) bearing broadleaved species. About 58 percent of the coniferous forests and 52 percent of the broadleaved areas are classed as accessible. Thus, there remain nearly 400 million hectares of conifers and 800 million hectares of broadleaved species which are as yet untapped and most of which constitute reserves for the more or less distant future.

The forest areas per caput shown in Tables 2 and 4 are calculated on the basis of productive forest area, rather than total forest area, because only the former class is capable of yielding continuing and diversified supplies of forest products. In Asia, the home of more than half of the world's people, there are only 0.3 hectares of forest land per person, while the corresponding figure for South America, 6.4 hectares, is 21 times greater. The average for the reporting countries of Europe, 0.3 hectares per caput, is the same as for Asia, but the nonreporting European countries and the U.S.S.R. taken together have 2.1 hectares per caput. In North America and Oceania there are 2.5 and 4.2 hectares per caput respectively, but Africa, often referred to as an undeveloped continent with vast untouched forest resources, has only 1.6 hectares of productive forest for each member of its population.

The forest areas per caput do not, by themselves, give an adequate idea of the relationship between forest areas and population in the different parts of the world. For example, although the forest area per caput appears to be about the same for the reporting countries of Europe and for Asia, practically all the European forest is accessible while a little more than one half of the Asian forest is not. On a continental

TABLE 3.—Classification of Productive Forests

Continent	Accessible Forests			Inaccessible Forests		
	Conifers	Broadleaved	Total	Conifers	Broadleaved	Total
	(Million hectares)					
Europe and U.S.S.R.						
Reporting countries	60	30	90	2	—	2
Nonreporting countries	256	78	334	210	91	301
Estimated Totals	316	108	424	212	91	303
North America[1]						
Reporting countries	175	127	302	130	26	156
Nonreporting countries	5	27	32	5	12	17
Estimated Totals	180	154	334	135	38	173
South America						
Reporting countries	8	248	256	4	301	305
Nonreporting countries	2	49	51	1	51	52
Estimated Totals	10	297	307	5	352	357
Africa						
Reporting countries	1	136	137	—	153	153
Nonreporting countries	1	12	13	—	3	3
Estimated Totals	2	148	150	—	156	156
Asia (excl. U.S.S.R.)[1]						
Reporting countries	24	98	122	36	93	129
Nonreporting countries	7	45	52	7	48	55
Estimated Totals	31	143	174	43	141	184
Oceania						
Reporting countries	3	13	16	—	8	8
Nonreporting countries	1	7	8	4	14	18
Estimated Totals	4	20	24	4	22	26
Estimated Grand Totals	543	870	1,413	399	800	1,199

[1]The total area of productive forest in Table 3 corresponds with that in Table 2. However, because a few countries reported productive area but did not report details given in Table 3, there are slight differences between the tables with respect to reporting and nonreporting countries.

basis, this factor alone reduces the forest area effectively available in Asia to 0.15 hectares per caput. Reference to Table 4 will show that in some Asiatic countries the available forest area is even less.

Forest Ownership

According to Table 6 the distribution of different forms of forest ownership varies widely from country to country. A great deal has been said and written regarding the respective merits of public and private ownership from the point of view of good forestry, but the evidence shows that the relative emphasis which should be placed on public ownership depends far more on the general political and social conditions within individual countries than it does on any absolute virtues inherent in any particular form of ownership. Although it is known that in certain countries the standard of forest management on public lands is far better than on private holdings, other instances can be found where publicly owned forests get little attention. On the other hand, reference to the table will show that in a number of countries of northwestern Europe, where general forestry standards are admittedly high, private ownership predominates.

Volumes of Standing Timber

Volumes of standing timber and average stands per hectare in reporting countries are shown in Table 7. Volumes per hectare for conifers and broadleaved species are based on the areas on which such species grow, rather than on total productive forest area. Here it should be pointed out that comparisons of average volumes per hectare from country to country are significant only if site conditions are more or less similar and if the status and methods of forest management are reasonably comparable. Quantities given in the table are averages in which areas of very young forests bearing little or no measurable volume may be lumped together with areas of mature timber. If the larger part of the forests is not actively being worked, even though classed as accessible, it is likely that the average volume per hectare will be higher than that in a country with forests of a generally similar type but all of which are being used.

Available estimates of growing stock in many tropical countries are concerned solely with species which are now marketable. Rapid advances in the adaptation of previously unused species to commercial purposes in the North Temperate Zone suggest that it may be advisable to make at least approximate estimates of the volumes of tropical species for which there is, as yet, no commercial demand.

Sustained Productive Capacity of the Forest

The reasons why preparation of a direct estimate of the relationship between current growth and current drain on a world-wide basis is not considered possible have already been discussed. It is possible, however, to estimate in a very general way the productive capacity of the world's forest soils. Indeed, such an estimate must be made to serve as a guide to the formulation of long-range policies looking toward the most effective use of the world's forests.

Coniferous Forests

About 36 percent of the productive forests are coniferous, but more than 70 percent of the demand for wood for use in construction and for industrial purposes is for coniferous species. It is to be expected, therefore, that it is in connection with the coniferous forests that a critical situation may be found to exist.

The three great conifer-producing regions are Europe, the U.S.S.R., and North America. In Europe the principles of forest management have been applied for a long period of time and much information regarding the yields obtained from coniferous forests has been accumulated. Nevertheless, it is known that many forests are not fully stocked, and that considerable opportunities for improving average yields still exist.

Table 9 shows that average growth rates for conifers in the reporting countries of Europe range downward from 7.3 m^3 (r) per hectare for Denmark to less than 2 m^3 (r) per hectare for several other countries. The low figures shown for Great Britain and Poland are estimates of actual growth at the present time in forests which suffered exceptional devastation during the war. The average of the rates actually reported for Europe is about 2.2 m^3 (r) per hectare but it seems possible to assume, without undue optimism, that it will be possible to increase this rate to about 3 m^3 (r) per hectare.

It has been estimated that the average rate of growth in forests of the U.S.S.R. is 2 m^3 (r) per hectare. In view of the northerly location of many of the coniferous forests of that country, it might be unwise to assume a higher average rate for the future.

The average growth rate reported for conifers in the United States is 2.3 m^3 (r) per hectare, and it is believed that in Canada the corresponding figure is in the order of 1 m^3 (r) per hectare. These figures, however, are different in character from the figures for Europe. In brief, they are based on the volumes which can be harvested at the end of a rotation and make little or no allowance for intermediate yields which, in Europe, would be harvested during the life of a stand. Introduction of better standards of forest management should make possible average rates of growth of 4 m^3 (r) in the United States and 2 m^3 (r) in Canada.

For present purposes an average rate of 2 m^3 (r) per hectare may be assumed for areas of coniferous forests found in other parts of the world, although it is known that some plantations of exotic conifers established in the South Temperate Zone are growing at rates five times as high.

In accordance with the above assumptions, and allowing for losses from natural causes of about 10 percent, it is estimated that, *given reasonably adequate management*, the accessible coniferous forests of the world could yield about 1,200 million m^3 (r) of wood annually, which is equivalent to a world-wide average net rate of 2.2 m^3 (r) per hectare of accessible coniferous forests.

On the whole, the coniferous forests now classed as inaccessible occupy localities where growing conditions are likely to be somewhat less favorable than in the accessible areas. Furthermore, it is possible that some of them are so difficult of access that they should not be considered as potential reserves for the future. Hence, it would be unwise to expect an average rate of yield better than two thirds of the rate in the accessi-

ble areas. On this basis it is estimated that the presently inaccessible coniferous forests can eventually provide about 600 million m^3 (r) annually.

It may be felt that the above calculations are based on rates that are unduly conservative, since many coniferous forests produce wood at much higher rates. But the rates used are based on averages in which growth in the best forests is averaged with that in the poorer stands. It may be possible to increase the growth rate in a small forest very considerably within a single generation, but to increase a national average rate will require great and concerted efforts and a considerable length of time.

Table 9 indicates that the reporting countries as a group consider that the average rate of exploitation of their accessible coniferous forests during the past 10 years has exceeded the actual rate of replacement, but not by a very large margin. On the other hand, it has been calculated that the coniferous forests, accessible and inaccessible, could eventually be made to yield annually a far greater quantity than has ever been taken from them in the past. It cannot be repeated too often or too strongly that this tentative estimate of possible future yields is predicated absolutely on the assumptions that all forests will eventually be managed in accordance with forestry principles and that forest devastation will be brought to a halt. Unless these conditions are fulfilled, the world will fall short of achieving the supplies of coniferous timber which are definitely within the bounds of possibility. However, universal introduction of improved forest management will take time and it must not be assumed that the current rate of world consumption of coniferous timber could safely be expanded at the present time.

Granting the need for larger supplies of coniferous wood than have been available in the past, each country will have to make decisions regarding the method or methods which seem most likely to meet its own particular requirements. For countries without coniferous forests the choice will be restricted to reliance on imports, plantation of new forests, or a combination of the two. Countries possessing large areas of conifers, though more fortunately situated, will be faced by problems of much greater complexity. Should the principal effort be directed toward increasing yields from forests now being exploited, toward establishment of new plantations, or toward opening up forests as yet inaccessible? If a combination of these methods seems desirable, in what proportions should available funds be divided among them? Here lie problems of the first magnitude in the field of forest economics.

It is obvious that decisions regarding future development of the forests of each country will be taken by its own government. It is equally obvious that, with regard to problems of supply for a whole continent in which the forests and forest industries of individual countries are complementary to one another, unilateral action by national governments cannot be expected to arrive at the best possible solutions. On the contrary, some measure of consultation between governments will be necessary in the common interest. Machinery for facilitating such consultation in Europe already exists in the newly established Commission for Forestry and Forest Products. A similar form of organization is already planned for Latin America and is likely to be needed in other regions.

Broadleaved Forests

About 64 percent of the total productive forest area of the world consists of broadleaved species. Of this proportion, so-called temperate hardwoods account for 14 percent and tropical hardwoods make up the remaining 50 percent. The general situations with respect to these two groups differ widely.

The average rate of growth for the temperate broadleaved forests of Europe is shown in Table 10 to be 2.0 m^3 (r) per hectare, or nearly the same as for conifers. A corresponding similarity exists in North America. In Europe there are indications of a moderate degree of overexploitation and it is known that the broadleaved forests in the Mediterranean area have been very heavily overcut in recent years in an effort to meet extreme shortages of fuel. The temperate broadleaved forests of North America, on the other hand, are not being fully exploited. Although there are local shortages of broadleaved woods within the Temperate Zone, it seems certain that these forests could provide substantially larger quantities of wood than are now being taken from them.

The situation in the tropical broadleaved forests is quite different. In most of the areas which are being exploited, only a few of the many species present have established places in the markets of the world and, in consequence, felling operations are highly selective. In general, the rate of utilization in the tropical forests is low, although overexploitation of certain individual species has undoubtedly occurred. The chief threat and source of damage arises, not from overexploitation for forest products, but from the practice of shifting cultivation and the uncontrolled use of fire to clear lands for planting and to improve grazing. These sources of destruction cannot be measured in terms of forest products, but they have caused and are still causing prodigious devastation. An eminent authority has recently stated that, "It seems reasonable to say that in tropical Africa today the forest area is about a third of what it could have been except for the ravages of fire and the destructive practices of the agriculturists."[1]

Estimates have been received showing average rates of total growth in the equatorial rain forests as high as 7 m^3 (r) per hectare per annum, with lower rates for the moist deciduous and dry deciduous types. Such estimates are based on total growth of all species regardless of their present marketability. Other estimates, confined to species which are now merchantable, show annual growth rates ranging from 0.3 to 1.5 m^3 (r) per hectare. Under existing circumstances it is virtually impossible to make rational estimates of the possible future productivity of the tropical forests. Before that can be done practical uses must be found for many more tropical species and, most important of all, the rate of forest destruction must be reduced to manageable proportions.

Supply vs. Demand

Estimates of over-all world consumption of forest products during the decade preceding the Second World War indicated an annual rate of about 1,500

[1]H. L. Shantz, Unasylva, Volume II, No. 2, page 67.

million m^3 (r) per annum. Recent estimates by FAO for the year 1946 indicated a figure about 6 percent lower, but for purposes of the present discussion the quantity quoted may be accepted as representing more or less normal consumption. Information on fellings obtained from the forest inventory inquiry is far from complete, but valuable additional data are available in the FAO *Yearbook of Forest Products Statistics, 1947*. From these and other sources certain general conclusions can be reached.

It is estimated that slightly less than 50 percent of the world consumption of wood is used for construction and for industrial purposes, and slightly more for fuel. Also, total consumption is almost equally divided between coniferous and broadleaved species. Of the coniferous wood, a little over 70 percent goes to building and industry and nearly 30 percent is burned. For the broadleaved species these proportions are almost exactly reversed.

It has been shown that, *given reasonably good forest management*, the accessible coniferous forests of the world should be capable of yielding about 1,200 million m^3 (r) of wood annually and that the inaccessible conifers may eventually yield an additional 600 million m^3 (r). In other words, it should eventually be possible to increase the output of conifers to two and one-half times its present volume. With respect to the broadleaved species the ultimate possibilities are still greater, although their realization depends on great technological advances and even greater changes in agricultural practices in the tropics.

Prewar estimates indicate that the average per caput consumption in North America was about 2.7 m^3 (r) of wood annually while that in Europe was slightly under 1.0 m^3 (r). These figures are indicative of the variation in rates of consumption which can exist in normal times between highly industrialized regions lying in the same general climatic zone. For the average inhabitant of densely populated Asia only 0.3 m^3 (r) was available. It is, then, very difficult to determine what average consumption rate is necessary to a reasonable standard of living. Perhaps the best tentative guide should be based on the relatively stabilized experience of prewar Europe, that is, about 1.0 m^3 (r) of wood per person. It seems evident that the forests of the world can be caused to yield that much wood in perpetuity for each member of a world population larger than the present one.

Regional Problems

The foregoing discussion shows that, from a global point of view, the productive forests of the world are inherently capable of yielding reasonably adequate supplies of forest products to meet the world's needs. There are, however, great obstacles to be overcome. One of the greatest of these arises from the differences between the distribution of populations and of forests.

Wood in its natural state is a bulky material and, in comparison with some other commodities, its value per unit of volume is low. These qualities place definite limitations, both physical and economic, on the distances over which large quantities of wood can be transported. Fuelwood, the cheapest of all forest products, usually must be grown near the point of its ultimate consumption. Logs and pulpwood to be processed by forest industries are frequently transported across the boundaries of adjacent countries, but the quantities which can be shipped from continent to continent are limited by considerations of cost as well as by availability of supplies. Sawn lumber, being more valuable than roundwood, can be transported profitably for greater distances, and newsprint paper apparently can be carried for any desired distance.

It seems evident that, although any continent may be able to draw on other continents for a proportion of its lumber and even for all of its wood pulp and bulk supplies of paper, it must provide its fuelwood and most of the wood required for industrial conversion from its own resources. Thus, large-scale industrialization in South America, where coniferous forests are few, would be likely to bring with it the adaptation of certain tropical broadleaved species to uses which in the North Temperate Zone have been served by conifers.

Conclusion

This report opens with a question as to whether or not man will be compelled in the future to resign himself to perpetual shortages of forest products. The answer is "No!" It has been shown that the forests of the world are capable of providing reasonably adequate supplies of their products to a population larger than now exists. But the provision of such supplies will entail treatment of all productive forests as renewable crops, opening up of forests which are not yet accessible, and cessation of the widespread devastation of forests which, in this twentieth century, still continues.

Equivalents, Abbreviations, and Symbols

In accordance with FAO's usual practice, the tables in this report are presented in units of the metric system of measurement. For the convenience of the reader more accustomed to English units, certain equivalents are given. Explanations of abbreviations and symbols used in the tables are also presented.

1 hectare = 2.471 acres
1 square mile = 259 hectares
1 cubic meter = 35.31 cubic feet
1 cubic meter per hectare = 14.29 cubic feet per acre
m^3 (r) = cubic meters of roundwood, without bark
= none, or negligible
... = not available

DEFINITIONS RELATING TO TABLES 4 AND 5

For definitions relating to Tables 6-10, see page 182

Classification	*Definition*
	TABLE 4—LAND CLASSIFICATION
FORESTED LANDS	Lands bearing vegetative associations dominated by trees of any size, capable of producing timber or other forest products or of exerting an influence on the climate or on the water regime. Also, lands from which forests have been recently clear cut or burned, but which will be reforested in the near future.
Productive forests	Forested lands physically capable of producing crops of usable wood.
Other forests	Forests incapable of yielding products other than fuel because of adverse site conditions. This category includes forests of slow growth and of dwarfed or stunted form.
NONFORESTED LANDS	
Cultivated lands and natural grasslands	Lands under cultivation, and natural grasslands whether used for grazing or not.
Other lands	Brush lands, moors, deserts, sand dunes, bare rock, swamps and bogs, also areas occupied by towns, roads, etc.

	TABLE 5—CLASSIFICATION OF PRODUCTIVE FORESTS
ACCESSIBLE FORESTS	Accessible forests are those which are now within reach of economic exploitation as sources of forest products, including immature forests. This category includes all productive forest lands owned by corporations or individuals, all publicly owned forests covered by working plans, and other public forests not covered by working plans but considered to be accessible for exploitation now.
Coniferous (softwoods)	Forests in which 75 percent or more of the volume of standing timber is of coniferous species.
Broadleaved (hardwoods)	Forests in which 75 percent or more of the volume is of broadleaved species.
Mixedwoods	All other forests.
INACCESSIBLE FORESTS	Forested lands of productive quality which are not yet economically accessible.
(Subdivisions same as for *Accessible Forests*)	

TABLE 4.—LAND CLASSIFICATION

Continent and Country	Population	Total Land Area	Forested Land: Productive Forest: Area	Forested Land: Productive Forest: Per Caput	Forested Land: Other Forest	Forested Land: Total Forest: Area	Forested Land: Total Forest: Percentage of Total Area	Cultivated Lands and Grasslands: Area	Cultivated Lands and Grasslands: Percentage of Total Area	Other Lands: Area	Other Lands: Percentage of Total Area
	Millions	*1,000 ha.*	*1,000 ha.*	*ha.*	*1,000 ha.*	*1,000 ha.*	*Percent*	*1,000 ha.*	*Percent*	*1,000 ha.*	*Percent*
EUROPE											
Austria	7.0	8,309	2,800	0.40	339	3,139	38	4,051	49	1,120	13
Belgium	8.4	3,044	541	0.06	—	541	18	1,735	57	768	25
Bulgaria	7.0	10,562	3,076	0.44	606	3,682	35	6,725	63	155	2
Czechoslovakia	13.1	12,694	3,983	0.30	40	4,023	32	7,532	59	1,139	9
Denmark	4.1	4,233	348	0.08	—	348	8	3,248	77	637	15
Finland	3.9	30,550	20,700	5.31	960	21,660	71	3,430	11	5,460	18
France	41.0	55,013	10,954	0.27	—	10,954	20	32,264	59	11,795	21
Germany	66.5	35,800	7,548[1]	0.11		7,548	21	20,690	58	7,562	21
Great Britain	49.6	22,745	1,273	0.03	—	1,273	6	18,241	80	3,231	14
Greece	7.4	12,800	600	0.08	1,400	2,000	16	9,900	77	900	7
Hungary	9.3	9,308	1,107	0.12	—	1,107	12	7,561	81	640	7
Ireland	2.9	6,889	89	0.03	—	89	1	4,677	68	2,123	31
Luxemburg	0.3	258	78	0.26	—	78	30	150	58	30	12
Netherlands	9.4	3,229	250	0.03		250	8	2,488	77	491	15
Northern Ireland	1.3	1,357	21	0.02	—	21	2	1,205	88	131	10
Norway	3.1	30,851	6,100	1.97	1,400	7,500	24	1,116	4	22,235	72
Poland	24.0	30,745	6,470	0.27	439	6,909	22	20,864	68	2,972	10
Portugal	8.2	8,771	2,460	0.30	7	2,467	28	3,420	39	2,884	33
Sweden	6.7	41,035	22,900	3.42	635	23,535	57	5,200	13	12,300	30
Switzerland	4.5	4,000	800	0.18	100	900	22	2,146	54	954	24
NORTH AMERICA											
Canada	12.3	896,685	210,596	17.12	123,763	334,359	37	61,228	7	501,098	56
Cuba	5.0	11,655	2,585	0.52	878	3,463	30	...	...	8,192[2]	70
El Salvador	2.0	3,413	1,992	1.00	—	1,992	58	...	...	1,421[2]	42
Guatemala	3.6	10,890	5,000	1.39	2,200	7,200	66	3,600	33	90	1
Newfoundland	0.3	9,586	3,753	12.51	687	4,440	46	41	—	5,105	54
United States	141.2	770,954	191,828	1.36	60,705	252,533	33	458,930	59	59,491	8
British:											
British Honduras	0.06	2,297	1,579	26.32	532	2,111	92	163	7	23	1
French:											
Guadeloupe	0.3	178	31	0.10	53	84	47	77	43	17	10
St. Pierre and Miquelon	0.004	23	—	—	1	1	4	3	13	19	83
United States:											
Alaska	0.08	147,715	47,755	596.94	14,164	61,919	42	15,783	11	70,013	47
Panama Canal Zone	0.06	94	56	0.93	—	56	60	12	12	26	28
Puerto Rico	2.1	891	80	0.04	8	88	10	657	74	146	16
Virgin Islands	0.03	34	8	0.27	3	11	32	18	53	5	15
SOUTH AMERICA											
Argentina	15.8	278,344	22,886	1.45	25,684	48,570	17	145,153	53	84,621	30
Brazil	46.7	851,119	377,170	8.08	18,758	395,928	46	151,390	18	303,801	36
Chile	5.4	74,177	6,682	1.24	9,541	16,223	22	18,523[3]	25	39,431	53
Colombia	10.3	105,941	72,000	6.99		72,000	68	25,046	24	8,895	8
Peru	7.8	112,460	50,000	6.41	20,000	70,000	62	15,120	14	27,340	24
Uruguay	2.3	18,617	452	0.20		452	2	14,284	77	3,881	21
British:											
British Guiana	0.4	20,849	13,986	34.96	4,144	18,130	87	388	2	2,331	11
Trinidad and Tobago	0.6	513	253	0.42	49	302	59	202	39	9	2
French:											
French Guiana	0.04	9,000	7,000	175.00	—	7,000	78	...	...	2,000[2]	22
Netherlands:											
Surinam	0.2	15,527	10,500	52.50	—	10,500	68	27		5,000	32
AFRICA											
Egypt	18.8	100,025	—	—	—	—	—	2,150	2	97,875	98
Union of South Africa	11.4	122,390	824	0.72	2,887	3,711	3	12,103	10	106,576	87
Belgian:											
Belgian Congo	10.6	228,393	119,500	11.27	800	120,300	53	...	...	108,093[2]	47
Ruanda-Urundi	4.0	5,219	156	0.39	182	338	6	...	...	4,881[2]	94

TABLE 4.—LAND CLASSIFICATION (*Concluded*)

Continent and Country	Population	Total Land Area	Forested Land: Productive Forest: Area	Forested Land: Productive Forest: Per Caput	Forested Land: Other Forest	Forested Land: Total Forest: Area	Forested Land: Total Forest: Percentage of Total Area	Cultivated Lands and Grasslands: Area	Cultivated Lands and Grasslands: Percentage of Total Area	Other Lands: Area	Other Lands: Percentage of Total Area
AFRICA (*Cont.*)	*Millions*	*1,000 ha.*	*1,000 ha.*	*ha.*	*1,000 ha.*	*1,000 ha.*	*Percent*	*1,000 ha.*	*Percent*	*1,000 ha.*	*Percent*
British:											
Anglo-Egyptian Sudan	6.6	250,582	3,497	0.53	89,743	93,240	37	1,606	1	155,736	62
Basutoland	0.6	3,035	10	0.02	....	10	....	3,021	100	4	
Bechuanaland	0.3	71,600	194	0.65	69,593	69,787	97	138	....	1,675	3
Gold Coast	3.6	23,783	9,065	2.52	6,993	16,058	67	7,068	30	657	3
Kenya	4.1	56,910	552	0.13	851	1,403	2	1,601	3	53,906	95
Mauritius	0.4	186	21	0.05	18	39	21	86	46	61	33
Nigeria	21.5	96,613	6,983	0.32	33,764	40,747	42	55,866	58		
Nyasaland	2.2	9,539	1,166	0.53	647	1,813	19	...	...	7,726[2]	81
Northern Rhodesia	1.7	75,188	5,439	3.20	28,231	33,670	45	...	...	41,518[2]	55
Southern Rhodesia	1.7	38,942	7,107	4.18	15,855	22,962	59	843	2	15,137	39
Sierra Leone	1.8	7,252	219	0.12	40	259	3	3,108	43	3,885	54
Swaziland	0.2	1,736	21	0.11	404	425	24	...	...	1,311[2]	76
Tanganyika	5.5	88,761	34,075	6.20	5,017	39,092	44	28,142	32	21,527	24
Uganda	4.0	20,796	503	0.13	1,000	1,503	7	4,240	21	15,053	72
French:											
Cameroun	2.8	42,000	18,800	6.71	10,000	28,800	69	13,000	31	200	....
Equatorial Africa	4.0	249,420	27,047	6.76	125,373	152,420	61	67,000[3]	27	30,000	12
Madagascar	4.4	59,470	2,500	0.57	4,500	7,000	12	40,270	68	12,200	20
Morocco	9.0	42,050	2,450	0.27	1,500	3,950	10	11,500	27	26,600	63
Somaliland	0.05	2,474	2	0.04	60	62	3	2	....	2,410	97
West Africa	16.2	468,000	50,000	3.09	120,000	170,000	36	35,000	8	263,000	56
Under Military Government:											
Cyrenaica	0.3	65,956	....	....	155	155	....	41	....	65,760	100
Eritrea	0.9	11,856	24	0.03	1,229	1,253	11	7,484	63	3,119	26
Somalia	0.9	68,000	64	0.07	7,836	7,900	12	3,100	4	57,000	84
Tripolitania	0.5	35,000	8	0.02	....	8	....	12,000	34	22,992	66
ASIA											
Burma	17.0	67,795	25,372	1.49	13,722	39,094	58	8,754	13	19,947	29
Ceylon	6.7	6,484	1,051	0.16	2,480	3,531	55	1,399	22	1,554	23
China	455.6	944,420	56,307	0.12	26,498	82,805	9	288,182	30	573,433	61
India and Pakistan[4]	310.6	222,388	33,296	0.11	11,234	44,530	20	...	...	177,858[2]	80
Japan	75.3	37,447	22,275	0.30	....	22,275	59	7,319	20	7,853	21
Palestine	1.9	2,630	8	0.004	81	89	3	697	27	1,844	70
Philippines	19.1	29,741	13,198	0.69	4,298	17,496	59	11,638	39	607	2
Siam	18.1	51,345	32,431	1.79	....	32,431	63	4,752[5]	9	14,162	28
Syria	3.0	18,560	100	0.03	275	375	2	6,338	34	11,847	64
Trans-Jordan	0.3	9,035	28	0.09	7	35	....	499	6	8,501	94
British:											
North Borneo	0.4	7,601	1,036	2.59	5,180	6,216	82	777	10	608	8
Cyprus	0.5	925	145	0.29	24	169	18	604	65	152	17
Malayan Union	5.9	13,225	7,340	1.24	2,784	10,124	77	2,801	21	300	2
Sarawak	0.5	11,940	3,885	7.77	6,734	10,619	89	...	...	1,321[2]	11
Netherlands:											
Netherlands Indies	75.3	190,435	70,000	0.93	50,000	120,000	63	...	...	70,435[2]	37
OCEANIA											
Australia	7.5	770,416	20,253	2.70	10,672	30,925	4	32,991	4	706,500	92
New Zealand	1.8	26,402	1,971	1.10	4,856	6,827	26	8,055	30	11,520	44
British:											
Fiji Islands	0.3	1,843	957[6]	3.19	....	957	52	192	10	694	38
French:											
New Caledonia	0.06	1,634	75	1.25	....	75	4	516	32	1,043	64
United States:											
Hawaii	0.5	1,667	773	1.55		773	46	647	39	247	15

[1]Does not include forests less than 10 hectares in area.
[2]Includes cultivated lands and grasslands.
[3]Includes some brushlands and moor.
[4]1938 estimates for areas formerly included in British India only.
[5]Cultivated lands only.
[6]Includes 20,000 ha. mangrove forests below high-water level.

TABLE 5.—CLASSIFICATION OF PRODUCTIVE FORESTS

Continent and Country	Total Productive Forest	Accessible Forests				Inaccessible Forests			
		Coniferous	Broad-leaved	Mixed wood	Total	Coniferous	Broad leaved	Mixed wood	Total
	(1,000 hectares)								
EUROPE									
Austria	2,800	1,600	300	600	2,500	220	40	40	300
Belgium	541	200	341	—	541	—	—	—	
Bulgaria	3,076	280	2,639	57	2,976	—	100	—	100
Czechoslovakia	3,983	2,120	927	936	3,983	—	—	—	
Denmark	348	199	149	—	348	—	—	—	
Finland	20,700	14,900	3,730	2,070	20,700	—	—	—	
France	10,954	2,957	7,997	—	10,954	—	—	—	
Germany	7,548	5,268	2,280	—	7,548	—	—	—	
Great Britain	1,273	477	616	180	1,273	—	—	—	
Greece	600	290	160	50	500	70	30	—	100
Hungary	1,107	71	1,036	—	1,107	—	—	—	
Ireland	89	23	23	43	89	—	—	—	
Luxemburg	78	17	58	3	78	—	—	—	
Netherlands	250	173	77	—	250	—	—	—	
Northern Ireland	21	10	11	—	21	...	...	—	
Norway	6,100	4,463	722	—	5,185	788	127	—	915
Poland	6,470	5,670	800	—	6,470	—	—	—	
Portugal	2,460	1,153	1,295	12	2,460	—	—	—	
Sweden	22,900	13,550	1,350	7,350	22,250	...	...	...	650
Switzerland	800	350	50	300	700	100	—	—	100
NORTH AMERICA									
Canada	210,596	53,314	20,250	39,031	112,595	74,672	6,623	16,706	98,001
El Salvador	1,992	81	23	1,888	1,992	—	—	—	
Newfoundland	3,753	3,727	—	—	3,727	26	—	—	26
United States	191,828	70,013	63,943	36,828	170,784	19,425	1,619	—	21,044
British:									
British Honduras	1,579	27	1,539	—	1,566	13	—	—	13
French:									
Guadeloupe	31	—	10	—	10	—	21	—	21
United States:									
Alaska	47,755	7,285	2,428	1,619	11,332	24,282	6,475	5,666	36,423
Panama Canal Zone	56	—	56	—	56				
Puerto Rico	80	—	76	—	76		4	—	4
Virgin Islands	8	—	8	—	8				
SOUTH AMERICA									
Argentina	22,886	40	17,056	42	17,138	80	5,650	18	5,748
Brazil	377,170	5,250	147,368	—	152,618	3,500	221,052	—	224,552
Chile	6,682	379	4,603		4,982	...	...	...	1,700
Colombia	72,000	—	57,000	3,000	60,000		11,300	700	12,000
Peru	50,000		15,000		15,000		35,000		35,000
Uruguay	452	7	367	4	378		74		74
British:									
British Guiana	13,986	—	3,626	—	3,626		10,360		10,360
Trinidad and Tobago	253	—	201		201		52	—	52
French:									
French Guiana	7,000	—	400	—	400		6,600	—	6,600
Netherlands:									
Surinam	10,500	—	2,000	—	2,000		8,500		8,500

TABLE 5.—CLASSIFICATION OF PRODUCTIVE FORESTS (*Concluded*)

Continent and Country	Total Productive Forest	Accessible Forests				Inaccessible Forests			
		Coniferous	Broad-leaved	Mixed-wood	Total	Coniferous	Broad-leaved	Mixed-wood	Total
	1,000 hectares								
AFRICA									
Union of South Africa	824	123	701	—	824				
Belgian:									
Belgian Congo	119,500	—	69,000	—	69,000	—	50,500	—	50,500
Ruanda Urundi	156	—	156	—	156	—			
British:									
Anglo Egyptian Sudan	3,497		1,295		1,295	52	2,150	—	2,202
Basutoland	10		10		10				
Bechuanaland	194		168		168		26	—	26
Gold Coast	9,065		4,131		4,131	—	4,934	—	4,934
Kenya	552	241[1]	311[1]		552	—	—	—	—
Mauritius	21	—	2	9	11	—	10	—	10
Nigeria	6,983		913		913	—	6,070	—	6,070
Nyasaland	1,166	2	518	—	520	1	645	—	646
Northern Rhodesia	5,439	—	5,439[1]		5,439[1]		—	—	—
Southern Rhodesia	7,107	1	5,474		5,475	3	1,629	—	1,632
Sierra Leone	219		12		12		207	—	207
Swaziland	21		21		21		—	—	—
Tanganyika	34,075		5,061	303	5,364	—	28,711	—	28,711
Uganda	503		299		299	—	204	—	204
French:									
Cameroun	18,800		2,300		2,300		16,500	—	16,500
Equatorial Africa	27,047		12,027		12,027		15,020	—	15,020
Madagascar	2,500		1,500		1,500		1,000	—	1,000
Morocco	2,450	400	1,750	300	2,450		—	—	—
French Somaliland	2					2	—	—	2
West Africa	50,000	—	25,000	—	25,000	—	25,000	—	25,000
Under Military Govt.:									
Eritrea	24		24		24				
Somalia	64		50	14	64				
Tripolitania	8		8		8				
ASIA									
Burma	25,372		25,372		25,372		—	—	—
Ceylon	1,051		1,008	1	1,009		42	—	42
China	56,307	12,669	2,534	1,689	16,892	33,503	3,153	2,759	39,415
India and Pakistan[2]	33,296	2,863	29,590	843	33,296		—	—	—
Japan	22,275	5,647	9,868	4,172	19,687	713	1,285	590	2,588
Palestine	8	7	1		8		—	—	—
Siam	32,431	48	10,731		10,779	190	21,462	—	21,652
Syria	100	7	10	3	20	28	40	12	80
Trans-Jordan	28	3	22		25	3	—	—	3
British:									
North Borneo	1,036		259		259		777	—	777
Cyprus	145	135	2	—	137		—	8	8
Malayan Union	7,340		2,034		2,034		5,306	—	5,306
Sarawak	3,885		3,885		3,885				
Netherlands:									
Netherlands Indies	70,000	10	10,990	—	11,000		59,000	—	59,000
OCEANIA									
Australia	20,253	1,478	11,869	292	13,669	124	6,434	26	6,584
New Zealand	1,971	635	40	41	716	162	810	283	1,255
British:									
Fiji Islands	957		20	890	910		—	47	47
French:									
New Caledonia	75		6	2	8		54	13	67
United States:									
Hawaii	773		449		449		324	—	324

[1]May include some inaccessible forests.
[2]See footnote 4, Table 4.

TABLE 6.—OWNERSHIP OF PRODUCTIVE FORESTS

Continent and Country	Total Productive Forests	Publicly Owned Forests: State Forests: Fellings Permitted	Publicly Owned Forests: State Forests: Fellings Prohibited	Publicly Owned Forests: Communal Forests[1]	Publicly Owned Forests: Total Public	Forests Owned by Institutions	Privately Owned Forests
	(1,000 hectares)						
Europe							
Austria	2,800	420	...	280	700	30	2,070
Belgium	541	57		195	252	9	280
Bulgaria	3,076	929	1	1,573	2,503	88	485
Czechoslovakia	3,983	1,835		498	2,333	236	1,414
Denmark	348	86		9	95	14	239
Finland	20,700	5,900	1,200	320	7,420		13,280
France	10,954	1,563	26	2,441[2]	4,030	...	6,924
Germany	7,548	3,414		2,015[2]	5,429	...	2,119
Great Britain	1,273	207			207		1,066
Greece	600	330	80	110	520	30	50
Hungary	1,107	828		25	853	1	253
Ireland	89	37			37		52
Luxemburg	78	2		29	31	1	46
Netherlands	250	38		37	75	13	162
Northern Ireland	21	8			8		13
Norway	6,100	445		391	836	86	5,178
Poland	6,470	5,395	13	320	5,728		742
Portugal	2,460	86	2	...	...	...	...
Sweden	22,900	4,340	35	800	5,175	325	17,400
Switzerland	800	45	5	535	585		215
North America							
Canada	210,596	178,703	5,180	767	184,650		25,946
Cuba	3,463[3]	878	68		946		2,517
Newfoundland	3,753	1,044[4]			1,044		2,709
United States	191,828	40,470	4,857	6,880	52,207	...	139,621[2]
British:							
British Honduras	1,579	541	259		800		779
French:							
Guadeloupe	31	22			22		9
United States:							
Alaska	47,755	45,731	1,619	405	47,755		
Panama Canal Zone	56		56		56		
Puerto Rico	80	31	4		35		45
Virgin Islands	8	4			4		4
South America							
Argentina	22,886	...	2,300	..	...	...	...
Brazil	377,170		392		392		376,778
Chile	6,682	2,318	540		2,858	180	3,644
Colombia	72,000	32,400	10,800	1,440	44,640		27,360
Peru	50,000	40,000	7,000	140	47,140		2,860
Uruguay	452	5	2		7		445
British:							
British Guiana	13,986	13,727[4]	...	129	13,856		130
Trinidad and Tobago	253	242[4]	...		242		11
French:							
French Guiana	7,000	7,000			7,000		
Netherlands:							
Surinam	10,500	2,000		8,380	10,380		120

TABLE 6.—OWNERSHIP OF PRODUCTIVE FORESTS (*Concluded*)

Continent and Country	Total Productive Forests	Publicly Owned Forests: State Forests: Fellings Permitted	Publicly Owned Forests: State Forests: Fellings Prohibited	Publicly Owned Forests: Communal Forests[1]	Publicly Owned Forests: Total Public	Forests Owned by Institutions	Privately Owned Forests
	1,000 hectares						
Africa							
Union of South Africa	824	257	—	18	275	—	549
Belgian:							
Belgian Congo	119,500	96,740	22,700	—	119,440	—	60
British:							
Anglo-Egyptian Sudan	3,497	3,497[4]	...	—	3,497		
Bechuanaland	194	155[4]	...	39	194		
Gold Coast	9,065	14[4]	...	9,051	9,065		
Kenya	552	469[4]	...	70	539	—	13
Mauritius	21	7	2	—	9	—	12
Nigeria	6,983	6,851[4]	...	60	6,911	—	72
Nyasaland	1,166	420[4]	...	657	1,077	—	89
Southern Rhodesia	7,107	7,098[4]	...	—	7,098	—	9
Sierra Leone	219	159[4]	...	60	219		
Swaziland	21	—	—	18	18	—	3
Tanganyika	34,075	33,876[4]	...	32	33,908	—	167
Uganda	503	477[4]	...	—	477	—	26
French:							
Cameroon	18,800	18,300	500	—	18,800		
Equatorial Africa	27,047	26,297	750	—	27,047		
Madagascar	2,500	1,100	1,000	—	2,100	—	400
Morocco	2,450	2,430	—	—	2,430	—	20
Somaliland	2	—	2	—	2		
West Africa	50,000	48,530	1,200	—	49,730	—	270
Under Military Govt.:							
Eritrea	24	9	13		22	—	2
Somalia	64	—	64	—	64		
Tripolitania	8	—	—	4	4	—	4
Asia							
Burma	25,372	25,372	...	...	25,372		
Ceylon	1,051	1,051[4]			1,051	—	
China	56,307	...	...	...	31,870	—	24,437
Japan	22,275	8,026	1	2,555	10,582	224	11,469
Palestine	8	4			4	4	
Philippines	13,198	11,172	1,396	285	12,853	—	345
Siam	32,431	32,431			32,431	—	
Syria	100	70		20	90	—	10
Trans-Jordan	28		27		—	—	1
British:							
North Borneo	1,036	1,010[4]	...		1,010	—	26
Cyprus	145	137[4]	...	2	139	—	6
Malayan Union	7,340	7,340[4]	...		7,340	—	-
Sarawak	3,885	622[4]	...	3,263	3,885	—	—
Netherlands:							
Netherlands Indies	70,000	62,000		8,000	70,000	—	—
Oceania							
Australia	20,253	14,002[4]	...	243	14,245	—	6,008
New Zealand	1,971	1,518[4]	...	52	1,570	—	401
French:							
New Caledonia	75	8	8	25	41	...	...
United States:							
Hawaii	773		303		303	...	470

[1]Includes forests reserved for the use or benefit of native tribes.
[2]Includes forests owned by institutions.
[3]Includes both "productive" and "other" forests.
[4]Includes forests in which fellings are prohibited.

TABLE 7.—GROWING STOCKS IN ACCESSIBLE PRODUCTIVE FORESTS

Continent and Country	Total Volume			Average Stand per Hectare		
	All Species	Conifers	Broadleaved	All Species	Conifers[1]	Broadleaved[1]
	Million m^3 (r)			m^3 (r)		
EUROPE						
Austria	348	310	38	139	163	63
Belgium	41	21	20	76	105	59
Bulgaria	152	42	110	51	136	41
Czechoslovakia	388	257	131	97	99	94
Denmark	19	11	8	55	55	54
Finland	1,006	807	199	49	51	42
France	700	266	434	64	90	54
Germany	819	562	257	109	107	113
Great Britain	62	23	39	49	41	55
Greece	44	30	14	88	95	76
Hungary	75	5	70	68	70	67
Ireland	3	2	1	34	45	22
Luxemburg	10	2	8	128	105	136
Netherlands	10	9	1	40	52	13
Northern Ireland	1	1	—	41	62	21
Norway	284	252	32	55	56	44
Sweden	1,175	1,007	168	53	58	33
Switzerland	170	120	50	243	240	250
NORTH AMERICA						
Canada	5,419	3,758	1,661	48	52	42
Newfoundland	87	87	—	23	23	
United States	12,149	8,128	4,021	71	92	49
British:						
British Honduras*	7.9	0.6	7.3	5	22	5
French:						
Guadeloupe	2	—	2	200	—	200
United States:						
Alaska	1,076	850	226	95	105	70
Puerto Rico	16	—	16	210	—	210
Virgin Islands	0.2	—	0.2	22	—	22
SOUTH AMERICA						
Chile	1,792	182	1,610	360	480	350
Peru	3,540	—	3,540	236	—	236
Uruguay	46	1	45	122	111	122
British:						
British Guiana*	366	—	366	100	—	100
AFRICA						
Union of South Africa*	46	16	30	56	130	43
Belgian:						
Belgian Congo	28,700	—	28,700	416	—	416
British:						
Bechuanaland*	0.2	—	—	1	—	—
Gold Coast*	123	—	123	30	—	30
Kenya*	32	8	24	58	33	77
Mauritius*	3		3	282	135	282
Nigeria*	23		23	25		25
Southern Rhodesia*	53	—	53	10	—	10
Sierra Leone*	0.3	—	0.3	27	—	27
French:						
Cameroun*	57	—	57	25	—	25
Equatorial Africa	3,203	—	3,203	266		266
Madagascar	375	—	375	250		250
Morocco	81	29	52	33	53	27
West Africa	1,050		1,050	42		42
Under Military Government:						
Somalia	2.4		2.4	37		37
Tripolitania	0.4		0.4	53	200	51
ASIA						
Ceylon	141		141	140		140
China	6,346[2]	5,330	1,016	113	110	128
India and Pakistan*[3]	650	208	442	20	63	15
Japan	1,224	645	579	62	83	48
Siam	2,150	6	2,144	199	125	199
Trans Jordan	1.3	0.4	0.9	50	133	39
British:						
Cyprus*	3.6	3.6		26	26	
North Borneo*	11		11	42		42
Netherlands:						
Netherlands Indies	1,102	2	1,100	100	200	100
OCEANIA						
Australia	340	17	323	249	105	268
New Zealand	50	31	19	70	47	316
French:						
New Caledonia*	0.1		0.1	13		13
United States:						
Hawaii*	5		5	11		11

*Commercially exploitable species only.
[1]Based on areas actually bearing these species. One half of the Mixedwood areas reported in Table 5 is treated as coniferous and one half as broadleaved.
[2]Includes volumes in accessible and inaccessible productive forests.
[3]See footnote 4, Table 4.

TABLE 8.—AVERAGE ANNUAL GROWTH AND ANNUAL DRAIN

All Species

Continent and Country	Accessible Productive Forests: Total Annual Growth: Volume	Total Annual Growth: Per Hectare	Losses from Natural Causes	Net Annual Growth	Average Annual Fellings	Balance + or —	Average Annual Fellings outside the Forest	Total Growth in Inaccessible Forests
	1,000 m³ (r)	*m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*
EUROPE								
Austria	8,250	3.3	20	8,230	7,000	+ 1,230	...	600
Belgium	1,393	2.6	174	1,219	1,219	0	80	
Bulgaria	5,350	1.8	—	5,350	4,900	+ 450	...	...
Czechoslovakia	11,100	2.8	694	10,406	13,480	— 3,074	17	
Denmark	2,350	6.8	70	2,280	2,350	— 70	...	—
Finland	40,800	2.0	1,700	39,100	34,500[1]	+ 4,600	...	...
France	...	2.6[3]	...	28,600	31,000	— 2,400	...	
Germany	...	3.6[3]	...	26,960	63,650[2]	—36,690	...	
Great Britain	1,317	1.0	50	1,267	4,580	— 3,313	71	—
Greece	950	1.9	6	944	1,144	— 200	25	240
Hungary	2,000	1.8	147	1,853	3,000	— 1,147		
Ireland	115	1.3	—	115	336	— 221	...	
Luxemburg	176	2.3	2	174	203	— 29	2	
Netherlands	650	2.6	2	648	250	+ 398	150	
Northern Ireland	76	3.6	4	72	61	+ 11	12	
Norway	11,600	2.2	1,000	10,600	10,000	+ 600	...	...
Poland	10,000	1.5	1,000	9,000	10,000	— 1,000	...	...
Sweden	46,600	2.1	1,000	45,600	41,200	+ 4,400	1,200	200
Switzerland	2,800	4.0	100	2,700	4,100	— 1,400	50	...
NORTH AMERICA								
Canada	86,727	0.8	24,171	62,556	69,289	— 6,733	...	48,006
Newfoundland	1,832	0.5	874	958	2,311	— 1,353	...	...
United States	378,638	2.2	41,885	336,753	344,994	— 8,241	...	...
British:								
British Honduras*	158	0.1	89	69	54	+ 15		..
French:								
Guadeloupe	40	4.0	...	...	4	...	...	...
United States:								
Alaska	22,146	1.9	15,802	6,344	566	+ 5,778		92,323
Puerto Rico	850	11.2	12	838	1,150	— 312	600	55
Virgin Islands	17	2.1	—	17	17	0		
SOUTH AMERICA								
Chile	20,164	4.0	31,889	11,725	4,888	—16,613	...	...
Uruguay	2,245	5.9	—	2,245	1,400	+ 845	...	350
AFRICA								
Union of South Africa	3,694	4.5	1,892	1,802	2,349	— 547	...	...
Belgian:								
Belgian Congo	483,000	7.0	...	...	430	...	...	...
British:								
Gold Coast*	1,294	0.3	1,165	129	162	— 33	...	219
Kenya*	1,018	1.8	85	933	512	+ 421	...	...
Southern Rhodesia*	1,441	0.3	...	...	1,962	...	...	...
Sierra Leone*	8	0.7	...	...	13	...	...	145
French:								
Cameroun*	1,150	0.5	50	1,100	100	+ 1,000	...	...
Equatorial Africa	36,000	3.0	...	...	500	...	...	9,000
Madagascar	3,000	2.0	96	2,904	15,000	—12,096	200	1,000
Morocco	1,154	0.5	130	1,024	1,300	— 276	350	
West Africa	25,000	1.0	20,000	5,000	2,000	+ 3,000	...	25,000
Under Military Govt.:								
Eritrea	91	3.8	16	75	26	+ 49	1	...
Tripolitania	24	3.0	...	24	17	+ 7	13	
ASIA								
Ceylon	421	0.4	70	351	126	+ 225	...	...
China	48,096	2.8	4,009	44,087	9,859	+34,228	493	52,926
India and Pakistan*[4]	46,048	1.4	1,436	44,612	...	...	...	...
Japan	40,466	2.0	581	39,885	66,517	—26,632	...	5,227
Trans Jordan	52	2.0	—	52	13	+ 39	...	8
British:								
Cyprus*	76	0.6	1	75	84	— 9	—	
North Borneo*	227	0.9	—	227	357	— 130	...	...
Netherlands:								
Netherlands Indies	...	...	...	11,000	3,500	+ 7,500	...	59,000
OCEANIA								
Australia	10,376	0.8	1,789	8,587	8,196	+ 391	...	...
New Zealand	1,699	2.4	283	1,416	2,351	— 935	...	...
French:								
New Caledonia*	2	0.3	...	2	4	— 2	...	9

*Commercially exploitable species only.

[1]1940-42.

[2]1947.

[3]Based on Net Growth.

[4]See footnote 4, Table 4

TABLE 9.—AVERAGE ANNUAL GROWTH AND ANNUAL DRAIN
Coniferous Forests

Continent and Country	Accessible Productive Forests: Total Annual Growth: Volume	Total Annual Growth: Per Hectare	Losses from Natural Causes	Net Annual Growth	Average Annual Fellings	Balance + or —	Average Annual Fellings outside the Forest	Total Growth in Inaccessible Forests
	1,000 m³ (r)	*m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*
Europe								
Austria	7,050	3.7	18	7,032	5,950	+ 1,082	...	550
Belgium	778	3.9	97	681	681	0		
Bulgaria	1,050	3.4	...	1,050	870	+ 180	...	...
Czechoslovakia	8,450	3.3	471	7,979	10,270	— 2,291	2	
Denmark	1,450	7.3	70	1,380	900	+ 480	...	
Finland	30,500	1.9	...	...	...	...	...	...
France	...	2.6[1]	...	7,720	9,150	— 1,430	...	...
Great Britain	850	1.5	28	822	2,614	— 1,792	14	
Greece	600	1.9	4	596	696	— 100	5	170
Ireland	67	1.5	—	67	123	— 56	...	
Luxemburg	67	3.5	2	65	93	— 28		
Netherlands	550	3.2	2	548	180	+ 368	...	...
Northern Ireland	56	5.6	3	53	33	+ 20	7	...
Norway	9,900	2.2	900	9,000	8,500	+ 500	...	...
Poland	9,300	1.6	1,000	8,300	9,300	— 1,000	...	
Sweden	39,000	2.3	900	38,100	35,200	+ 2,900	1,100	200
Switzerland	2,000	4.0	100	1,900	2,900	— 1,000	...	...
North America								
United States	191,330	2.2	22,741	168,589	208,095	—39,506	...	...
British:								
British Honduras*	17	0.6	28	— 11	4	— 15		...
United States:								
Alaska	13,990	1.7	9,940	4,050	566	+ 3,484		68,818
South America								
Chile	2,668	7.0	2,762	— 94	543	— 637	...	...
Uruguay	45	5.0	—	45	30	+ 15	...	...
Africa								
Union of South Africa	1,143	9.3	71	1,072	350	+ 722	...	...
British:								
Kenya*	576	2.4	56	520	70	+ 450	...	...
Southern Rhodesia*	14	14.0	...	...	3	...	...	...
French:								
Morocco	74	0.1	—	74	65	+ 9	...	...
Under Military Government:								
Tripolitania	1.7	17.0	—	1.7		+ 1.7	...	...
Asia								
China	37,408	2.8	3,367	34,041	6,901	+27,140	345	41,149
India and Pakistan*[2]	2,291	0.7	144	2,147	...	...	...	...
Trans-Jordan	7.2	2.4		7.2	0.3	+ 6.9	...	8
British:								
Cyprus*	76	0.6	1	75	84	— 9		
Oceania								
Australia	1,524	0.9	14	1,510	854	+ 656	...	...

*Commercially exploitable species only.
[1]See footnote 3, Table 8.
[2]See footnote 4, Table 4.

TABLE 10.—AVERAGE ANNUAL GROWTH AND ANNUAL DRAIN

Broadleaved Forests

Continent and Country	Accessible Productive Forests: Total Annual Growth: Volume	Total Annual Growth: Per Hectare	Losses from Natural Causes	Net Annual Growth	Average Annual Fellings	Balance + or −	Average Annual Fellings outside the Forest	Total Growth in Inaccessible Forests
	1,000 m³ (r)	*m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*	*1,000 m³ (r)*
EUROPE								
Austria	1,200	2.0	2	1,198	1,050	+ 148	...	50
Belgium	615	1.8	77	538	538	0	80	—
Bulgaria	4,300	1.6	...	4,300	4,030	+ 270	...	...
Czechoslovakia	2,650	1.9	223	2,427	3,210	− 783	15	...
Denmark	900	6.0	—	900	1,450	− 550	...	
Finland	10,300	2.2	...	...	...	...	...	...
France	...	2.6[1]	...	20,880	21,850	− 970	...	...
Great Britain	467	0.7	21	446	1,965	− 1,519	56	
Greece	350	1.9	2	348	448	− 100	20	70
Ireland	48	1.1	—	48	213	− 165	...	
Luxemburg	109	1.8	—	109	111	− 2	2	—
Netherlands	100	1.3	—	100	70	+ 30	1	—
Northern Ireland	20	1.8	1	19	28	− 9	5	—
Norway	1,700	2.4	100	1,600	1,500	+ 100	...	400
Poland	700	0.9	...	700	700	0	...	
Sweden	7,600	1.5	100	7,500	6,000	+ 1,500	100	...
Switzerland	800	4.0	—	800	1,200	− 400	50	...
NORTH AMERICA								
United States	187,308	2.3	19,144	168,164	136,899	+31,265	...	...
British:								
British Honduras*	141	0.9	61	80	50	+ 30		...
French:								
Guadeloupe	40	4.0	...	...	4	...	...	...
United States:								
Alaska	8,156	2.5	5,862	2,294	—	+ 2,294		23,505
Puerto Rico	850	11.2	12	838	1,150	− 312	600	55
Virgin Islands	17	2.1	—	17	17	0		
SOUTH AMERICA								
Chile	17,497	3.8	29,127	−11,630	4,346	−15,976	...	...
Uruguay	2,200	6.0	—	2,200	1,370	+ 830	...	...
AFRICA								
Union of South Africa	2,551	3.6	1,821	730	1,999	− 1,269	...	...
Belgian:								
Belgian Congo	483,000	7.0	...	...	430	...	...	...
British:								
Gold Coast*	1,294	0.5	1,165	129	162	− 33	...	219
Kenya*	441	1.4	28	413	442	− 29	...	...
Southern Rhodesia*	1,426	0.3	...	...	1,959	...	...	...
French:								
Equatorial Africa	36,000	3.0	...	...	500	...	...	9,000
Madagascar	3,000	2.0	96	2,904	15,000	−12,096	200	1,000
Morocco	1,080	0.6	130	950	1,235	− 285	...	...
West Africa	25,000	1.0	20,000	5,000	2,000	+ 3,000	...	25,000
Under Military Government:								
Tripolitania	22	2.8		22	17	+ 5	13	...
ASIA								
Ceylon*	421	0.4	70	351	126	+ 225	...	...
China	10,688	3.2	642	10,046	2,958	+ 7,088	148	11,777
India and Pakistan*[2]	43,757	1.5	1,291	42,466	...	...	...	...
Trans-Jordan	45	2.0		45	13	+ 32	...	
British:								
North Borneo*	227	0.9	...	227	357	− 130	...	...
OCEANIA								
Australia	8,852	0.7	1,776	7,076	7,342	− 266	...	...

*Commercially exploitable species only.
[1]See footnote 3, Table 8.
[2]See footnote 4, Table 4.

DEFINITIONS RELATING TO TABLES 6-10

Classification	*Definition*
TABLE 6—OWNERSHIP OF PRODUCTIVE FORESTS	
PUBLICLY OWNED FORESTS	
State forests	Productive forested lands owned by national, state, provincial, and cantonal governments, etc., and forests of government-owned corporations.
Forests in which felling is prohibited	National parks and other recreational forests and forests maintained for the protection of watersheds, etc., from which removal of forest products is prohibited.
Forests in which fellings are permitted	National, state, provincial, and cantonal forests in which fellings, either by the state or by private operators, may be permitted.
Communal forests	Forests belonging to towns, villages, and communes. This heading also includes forests reserved for the use of native tribes or managed for their benefit.
FORESTS OWNED BY INSTITUTIONS	Forested lands owned by religious or educational institutions.
PRIVATELY OWNED FORESTS	Forested lands owned by industrial partnerships, corporations, and co-operative societies; forested estates, owned by individuals or single families; and forested areas within the boundaries of farms.
TABLE 7—GROWING STOCK IN ACCESSIBLE PRODUCTIVE FORESTS	
TOTAL VOLUME	The total volume of wood, without bark, contained in all trees 10 cm. or more in diameter measured over bark at a point 1.3 meters above ground level. Volume is expressed in cubic meters of roundwood, represented in the table by the symbol m^3 (r).
VOLUME PER HECTARE	In computing volumes per hectare of conifers and broadleaved woods, one half of the mixedwood areas reported in Table 5 was considered to bear conifers and the other half broadleaved species.
TABLES 8, 9, AND 10—AVERAGE ANNUAL GROWTH AND ANNUAL DRAIN	
GROWTH AND DRAIN IN ACCESSIBLE PRODUCTIVE FORESTS	
Total annual growth (gross increment)	The total volume of wood produced by all trees in the forest computed as an annual average for a 10-year period.
Losses from natural causes	Average volume of roundwood rendered unusable annually during the past 10 years by forest fire; by insect pests and tree diseases; and by climatic factors such as windstorms, ice, etc.
NET AVERAGE ANNUAL GROWTH	The net volume remaining after subtracting natural losses, as defined above, from total annual growth.
AVERAGE ANNUAL FELLINGS	Average volume of roundwood, exclusive of bark, felled annually in the forests during the past 10 years, whether removed from the forest or not.
BALANCE OF GROWTH AND DRAIN	The difference between the volumes of annual fellings and net annual growth. The plus sign means that growth exceeded fellings, and the minus sign that fellings exceeded growth.
GROSS INCREMENT IN INACCESSIBLE FORESTS	Estimated total annual growth in inaccessible forests without deductions for natural losses. This estimate is requested as a rough indication of the supplies which might be obtained in the future if forests now unused were to be placed under management.
ESTIMATED AVERAGE VOLUME TAKEN FROM TREES OUTSIDE THE FOREST	Average volume of wood used annually which is not secured from the forests, but from "field" trees, roadside trees, etc.

Aerial Photography

By STEPHEN H. SPURR

This article describes and evaluates the use of aerial photographs in the field of forestry, particularly in making vegetation and land-use surveys and in making forest inventories. This recent and ever-developing technique, when properly co-ordinated with ground work, offers great opportunities for speeding up and putting on a uniform basis the knowledge of the forests of the world that is now much needed.

A TOOL IN VEGETATION AND LAND-USE SURVEYS

For all students of the land, there is a continuing need for new tools and techniques by which the condition of the land, its vegetation, and its culture can better be understood and evaluated. The aerial photograph is perhaps the most important of these to be adapted for this purpose in recent years. Aerial photographs have been used in the mapping of vegetation since 1920, but their development as a major tool in forestry and related fields has come about in the United States since 1940. Modern techniques involving the use of aerial photographs have been made possible by the availability of high-grade photographs at a low cost, coupled with the development of simple photogrammetric instruments, and of photo-mensurational techniques. Wherever knowledge concerning land forms, vegetation, and land use is required, the aerial photograph is fast becoming essential.

The principal advantage of aerial photographs in vegetation and land-use surveys lies in the fact that they provide a permanent record of conditions which is available in the office for detailed analysis. When studied with the aid of the stereoscope, they present a three-dimensional picture of the terrain seen from directly above. Species may be identified and their images measured with a surprising degree of accuracy. Maps can quickly and accurately be prepared from photographs. Units of vegetation and of land use can be delineated from the photographs and their areas determined with greater accuracy than is possible in the field in any reasonable amount of time.

In using aerial photographs, as with using any other tool, the first concern must be to select a tool of high quality, tailored to fit individual needs. Only by so doing will the photographer possess a tool of the greatest possible usefulness.

Specifications of Aerial Photographs

Aerial photographs are of many types, but those commonly used meet a fairly standardized set of specifications. They are generally 23 cm. (9 in.) square and are taken with the camera pointed vertically from an airplane flying parallel strips in a cardinal direction. Successive photographs in each strip are taken so that each photograph covers 60 percent of the area covered by the previous exposure. This endlap is necessary for stereoscopic vision and for photographic triangulation. Adjoining strips generally overlap on the edges (sidelap) about 30 percent.

To be satisfactory for mapping and accurate photo-interpretation, the photographs must be taken with a minimum of tilt (less than 3 degrees) by a trained crew using a precision aerial camera.

Oblique photographs are useful for illustrative purposes but, in comparison with vertical photos, are of relatively little value in forestry work. Enlargements are excellent for office records, but are less satisfactory than contact prints in the field and in stereoscopic study. Mosaics — several photographs pieced together in either an accurate (controlled) or an approximate (uncontrolled) manner—provide a useful substitute, but cannot be studied three-dimensionally.

Of the many specifications concerning aerial photographs other than those that are fairly well standardized, the most important in vegetation and land-use surveys are probably: (1) date, (2) scale, (3) focal length of camera, (4) season, (5) time of day, and (6) film and filter combination utilized.

First of all, the photographer must obtain photographs of recent vintage. Photographs taken ten years ago picture the land as it was ten years ago, and it is surprising to see how many changes occur in the landscape over such a short period. In some sections of the United States, it is almost impossible to correlate present day landscape with the image of the landscape as it was a decade before.

The scale of aerial photographs, too, is highly important. Scale is a function of the altitude of the photographic plane and the focal length of the aerial camera, as expressed by the formula: $RF = f/H$, where RF is the scale expressed as a natural ratio or representative fraction, f is the focal length of the camera in feet, and H is the height of the plane above the ground in feet. For instance, if a plane flying 2,514 m. (8,250 ft.) above the ground takes a picture with a camera having a lens of 0.21 cm. ($8\frac{1}{4}$ in. = 0.6875 ft.), the scale is 1:12,000, or 1,000 ft. to the inch.

Since the height of the plane above the ground varies constantly in hilly country, a photograph has as many different scales as the ground has different elevations. Consequently, the scale given for a photograph generally refers to the scale at an average

Figure 1. Aerial photograph of part of the Harvard Forest. Scale 1:18,000. Area covered 4,200 acres (1,700 ha.).

Figure 2. Harvard Forest. Scale 1:12,000. Area covered 2,000 acres (800 ha.).

ground elevation or to the scale at the center of the photograph. At the higher elevations, the height of the plane above the ground is less, and the scale of the photograph larger; at the lower elevations, the scale is smaller.

The standard U. S. Department of Agriculture photograph at the scale of 1:20,000, or 1,667 ft. to the inch, provides a general idea of the entire landscape but is of limited value in the detailed study of a portion of the terrain. Photographs taken for the U. S. Geological Survey are on an even smaller scale and can be used only with difficulty in land-use studies. At the other extreme, photographs taken at a very large scale such as 1:4,800, or 400 ft. to the inch, rob the observer of the perspective so valuable in aerial study. Furthermore, the number of photographs to be handled increases as the square of the scale. For instance, sixteen times as many photographs are needed to cover an area at 1:5,000 as at 1:20,000. Since the cost of mapping varies approximately with the number of photographs that must be handled, the cost of a land-use study at 1:5,000 should be about sixteen times as expensive as one carried out at a scale of 1:20,000. Taking into consideration the cost of photography, the number of photographs required, and requirements for visibility, the ideal scale for land-use purposes seems to be somewhere between 1:12,000 and 1:15,840 or between 1,000 ft. to the inch and 1,320 ft. to the inch. Within this range, the photographs are at a sufficiently large scale that the individual trees and shrubs can be clearly seen and studied, and yet at a sufficiently small scale that each photograph covers about 1,000 ha. (4 sq. mi.) and the cost of photography is not exorbitant.

The effect of scale upon the appearance and usability of aerial photographs may be illustrated by four photographs of the Harvard Forest Headquarters and the Prospect Hill Tract of the Forest in Petersham, Massachusetts. Figure 1, at a scale of 1:18,000 or 1,500 ft. to the inch, covers an area of approximately 1,700 ha. (4,200 acres). The thousand-acre parcel of the Harvard Forest is centered in the one photograph, but the individual stands are too small for detailed study. In this and the two succeeding photographs, the small clearly square dark stand immediately east of the Headquarters buildings is a red pine plantation almost exactly one acre in area.

The second photograph (Figure 2) is at a scale of 1:12,000 or 1,000 ft. to the inch. About 800 ha. (2,000 acres) are covered, or only about one half the area covered in Figure 1. It will be noted, though, that the coverage is sufficiently great to provide a good idea of the countryside, and that the detail is sufficiently good that much information can be gleaned from a stereoscopic study under magnification of the original nine-inch-square contact print.

Figure 3 has a scale of 1:600, or 500 ft. per inch. Covering less than 200 ha. (500 acres), it provides great detail, but only a limited idea of surrounding terrain. While yielding much information, extended coverage at such a large scale would be exorbitant and would necessitate the handling of excessive numbers of photographs.

Finally, a small portion of the east-central part of Figure 1 is portrayed at a scale of 1:300, or 250 ft. per inch in Figure 4. Barely sufficient detail is pictured in the slightly more than 40 ha. (100 acres) covered to locate the area. Perspective and continuity are both lost. Here is a case of not being able to see the forest for the trees. Such a large scale has little use in normal studies of vegetation and land use.

Most commercial aerial photography is done between 1,500 and 4,900 m. (5,000 and 16,000 ft.), because the air is too rough beneath that zone and oxygen apparatus is required above it. Consequently, once the scale of photography is chosen, choice of the focal length of the camera is limited. Most forestry photography is done with cameras having a focal length of 15 cm. (6 in.), 21 cm. (8¼ in.), and 30 cm. (12 in.). The shorter the focal length at a given scale of photography, the lower the plane will fly and the greater will be the displacement of images in the photograph. Great displacement is desirable in flat country because it accentuates the height of the trees in the stereoscopic image, but it is undesirable in rough country because topographic features are displaced and the photograph becomes highly distorted.

The season of year, also, is highly important. Photographs taken in the spring and fall may portray the various species in contrasting tones. Good photographs in these seasons, however, are very difficult to obtain, because the weather is suitable for aerial photography on only a very few days in any one month, and the chances of being able to photograph the vegetation at just the right stage of coloration are rather slight in any one season. Furthermore, the tone in which the vegetation registers may well vary from the north to the south end of the strip, from low to high elevations, and from frost pockets to ridge top. Consequently, spring and fall photography are seldom resorted to in large photographic surveys. Winter photography, too, has serious drawbacks to anyone interested in vegetation. When the foliage is off deciduous plants, no part of the plant is large enough to resolve in average-scale photographs and, consequently, areas of deciduous vegetation appear open and slightly out of focus on winter photographs. For the engineer, of course, winter photographs have many advantages, because without the deciduous vegetation much more can be learned about the ground beneath; but for the forester, the botanist, and anyone else interested in vegetation, principal reliance must be placed upon summer photography, when the foliage is in normal green coloration. Particularly in mountainous country is it important that photographs be taken during the middle hours of the day, so that massive shadows may be avoided. Such shadows often obscure detail and make complete interpretation of the prints difficult or impossible.

Assuming that summer photographs are required, the type of film and filter utilized will have an important bearing upon the value of the photographs for land-use studies. Photographs taken on panchromatic film will be excellent in detail but are apt to portray vegetation in such a uniform tone that distinctions between species, sites, and other important details are apt to be lost. Photographs taken on infrared film with visible light excluded by means of a deep red filter register the conifers in dark tones and the hardwoods in light tones. On them, many species can be recognized. The photographs are apt to be made up of intense blacks and whites and to have so much contrast that the detail is poor. Furthermore, shadows register in true blacks and may be very annoying. The most useful type of photograph for land-use purposes currently known is the modified infrared, i.e., a photo-

Figure 3. Harvard Forest. Scale 1:6,000. Area covered 500 acres (200 ha.).

graph taken on infrared film by the means of a light-colored filter which allows the visible as well as the infrared light to pass through the lens. Such a photograph is a compromise between the normal panchromatic and normal infrared photographs, and it combines much of the good detail of the panchromatic with much of the good tone variation of the infrared.

The appearance of these standard types of black and white photography is illustrated by three photographs taken during the summer of a portion of the Harvard Forest in central Massachusetts. All were taken at a scale of 1:12,000. In Figure 5, the panchromatic photograph, the detail is clearly defined and the distinctions between open and forested land readily apparent. Variations in composition within the forest, however, are hardly evidenced. The normal infrared photograph, Figure 6, sharply differentiates between the black of the white pine stands, the medium gray of the hemlock, and the light tones of the hardwood. The open land is much less apparent, and a stereoscopic examination would reveal a slight fuzziness in detail throughout, due to the excessive contrast of the print. The modified infrared photograph, Figure 7, looks more like the panchromatic, and indeed has the good detail and normal appearance of that type but maintains most of the tone variations between species which are so excessively brought out in the normal infrared. The modified infrared is a compromise and one well suited to widespread use.

Figure 8, a map of the area shown in Figures 5, 6, and 7, is included to illustrated the manner in which different forest types can be mapped from aerial photographs. The code letters indicate the individual species and the height and density of each stand. WP, for example, indicates white pine, T is hemlock, RO is red oak, RM red maple, PB paper birch, etc. The numbers show the average height of the trees in 10-foot classes. Hence WP-9 means white pine between 80 and 90 feet high. The final letters indicate stand density, A being the most dense and D the least dense.

Color photography has not yet advanced to the point where good color photographs can be consistently taken. Even the best color photographs taken today have poorer resolution of detail and less variation in tone within the grains than the average panchromatic and infrared photographs.

To sum up present-day knowledge as to the proper specifications for photographs to be used in land-use studies, it would appear that vertical aerial photographs of recent vintage, taken during the period of normal coloration of the foliage by the modified infrared technique, are required. Probably, a scale of 1:12,000 and 1:18,000 (between 1,000 and 1,500 ft. to the inch) is desirable.

Use of Aerial Photographs in Surveys

Photographs of the proper specifications can be used in two general ways. First, by photogrammetric methods, maps may be constructed showing the distribution of physiographic units, vegetation, and land-use types, and our natural units may be classified to almost any desirable degree. Secondly, through photo-interpretation, the photographs may be studied under a stereoscope and thus is seen in three-dimensional miniature a bird's-eye view of the terrain, complete

with infinite detail of vegetational and land-use patterns.

The problem of surveying and map-making from photographs is complicated by the fact that the aerial photograph is not a map. It is rather a picture distorted among other causes by: (1) topographic displacement, (2) tilt of the airplane and the camera at the moment of photography, and (3) film and paper shrinkage. Mountain tops, for instance, will be registered on aerial photographs farther away from the center of the photograph than they actually are. Conversely, valleys will register closer to the center. In a photograph of an average scale of 1:16,000 or 4 in. to the mile taken over an area of moderate relief in central New York, for instance, the image of many objects around the edge of the photographs will be displaced 0.6 cm. (¼ in.), representing more than 90 m. (300 ft.) on the ground.

If the photographs are truly vertical, or within one or two degrees of being vertical, however, all displacement will be radial from the center, that is, a radial line drawn from the center or principal point of the photograph through the image of the object will somewhere pass through the true location of that object. The true location of an object, therefore, cannot be determined on a single photograph but can be found by triangulation from the centers of two or more photographs on which the image of that object can be seen.

A great majority of the small scale maps (1:10,000 or smaller) constructed today are made from aerial photographs by means of techniques based upon this radial line principle. Provided that a series of points visible on the aerial photographs are carefully located by ground surveying, the position of a series of points on each and every photograph can be rapidly plotted by radial line triangulation. A large triangulation network, constructed with a separate mechanical templet for each photograph, is illustrated in Figure 9. The procedure is analogous to conventional plane-table triangulation, each photographic center being a triangulation station.

Once a radial line control network has been established, it then remains to transfer detail from photographs to the map established by this network of points. A wide variety of transfer devices exists, but only the less expensive and the simpler types can be feasibly utilized by the average user of photographs. Such a transfer device is the reflecting projector, which looks and operates much like a photographic enlarger, and by which the photographic image can be projected onto the radial line network of points. Devices utilizing the semitransparent mirror, too, can be used. Various types of camera lucida are on the market, of which the Rectoplanigraph is one of the more recent versions (Figure 10). With these, the image of a single photograph can be superimposed on the radial line network and photographic detail can be traced directly. Another, the Multiscope, is a combination of the mirror stereoscope and the camera lucida in a highly flexible form (Figure 11). With it, the stereoscopic image rather than the single photograph can be superimposed upon a radial line net or map of a widely different scale. With these and with several other instru-

Figure 4. Harvard Forest. Scale 1:3,000. Area covered 100 acres (40 ha.). Photographs for Figures 1, 2, 3, 4, and 10 courtesy Fairchild Aerial Surveys, Inc.

ments, it is possible to transfer detail from the photographs to the map, correcting in the process the distortions and the displacements of the photograph. Thus, a reasonably accurate map can be constructed from the photographs for only a few dollars per square mile. Only a minimum amount of terrestrial surveying is necessary and only a few days are needed to make a detailed map of an area showing the distribution of vegetation and land-use types.

If a topographic map is desired, simple contouring devices are available. A view of a laboratory designed for the use of aerial photographs in forestry and land-use studies is given in Figure 12. In this room at the Harvard Forest are developmental models of the Multiscope, a camera lucida of the Sketchmaster type on the central table, mirror and lens stereoscopes on the tables along the wall, and a fluorescent light table at the right.

A great and obvious value of aerial photographs in land study is in the mapping of vegetation. The size, shape, and character of homogeneous vegetation and

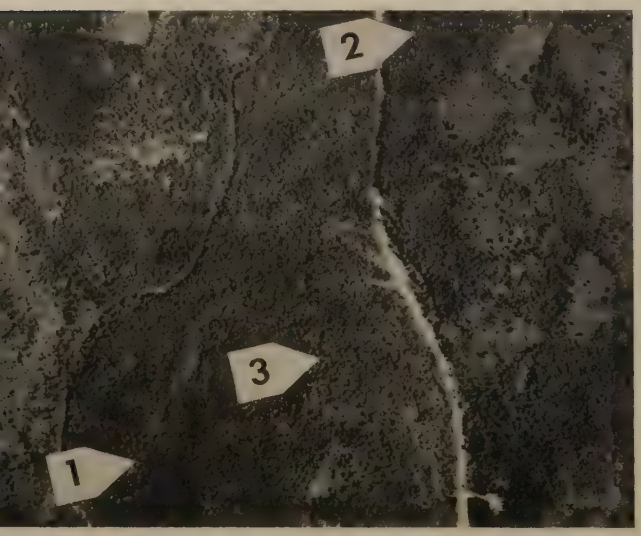


Figure 5. Panchromatic photograph showing good detail but little variation of tone within the forest.

land-use units is quickly apparent under the stereoscope. Unit boundaries can be accurately seen and transferred to a base map. With an instrument such as the Multiscope, which was developed specifically for forest mapping, the stereoscopic image can be superimposed upon a base map of the same or different scale, and a map of a complete stand turned out in a single operation. From 1,200 to 12,000 ha. (3,000 to 30,000 acres) can be classified into forest stands per man day. The amount of checking necessary in the field will be determined by the quality of the photographs available, the skill of the interpreter and mapper (two-man crews are generally used), and the map classification system used.

The map classification system will greatly affect the speed of the photographic mapping of stands in forestry and related fields, the amount of field checking required, and the value of the map in controlling subsequent inventory work. The most desirable classification in forestry is one based upon the variables which can be recognized and accurately determined on aerial photographs—that is, a system in which the variables are selected from type, stand density, tree height, crown diameter, and topographic site. Conversely, the least desirable systems are those based upon variables not recognizable on aerial photographs—such as merchantability, stem diameter, and site-class, variables which require extensive field checking for accurate determination.

The choice of the classification system will depend upon the purpose of the inventory, the forest area involved, and the quality and specifications of available photographs. For most projects, however, a three-part code classification, indicating (1) species, (2) height, and (3) density, seems to be basic. For instance, P5A would indicate a pine stand, 13 to 17 m. (45 to 55 ft. high), and more than 85 percent stocked. Through combination, practically any forest stand can be accurately characterized. In certain regions, and under certain conditions, it may be advisable to add or substitute a code for crown diameter or one for topographic site.

So much for aerial surveying techniques. Possibly of greater use in land-use and land-use planning studies is the information which can be obtained by the stereoscopic study of the photographs without recourse to mapping techniques.

The art of recognizing features in aerial photographs is a highly skilled one. Particularly on vertical photographs, familiar objects may not be recognized because of the unfamiliar vantage point. Considerable information can be gleaned from single photographs by observing the horizontal size and shape of objects, shadows, tone, and relative arrangement. Much more information can be obtained from the three-dimensional stereoscopic image. As a result, all photo-interpretation, both in the office and in the field, should be done with the aid of the stereoscope.

For most purposes, a simple lens type stereoscope (Figure 13) is preferable, as it is portable, is easy to use, and provides adequate magnification. Mirror stereoscopes, of which the Multiscope represents a more complex type, permit the entire stereoscopic overlap to be studied at one time but are expensive and reduce the scale of the image. In using stereoscopes, care should be taken to align the photographs carefully along the line of flight. The procedure, detailed in most works on photogrammetry, provides the best possible stereoscopic image and eliminates eyestrain.

The main guides to object recognition on aerial photographs are the pictorial elements of shape, dimension, tone, texture, and shadow pattern. Occasionally a single one of these pictorial elements will serve to identify an object but more often several elements must be taken into consideration.

For example, consider that there is a dark area on an infrared photograph. From the dark smooth texture, it is evident that it is water. Irregularities on the surface, however, caused by objects of lighter tone and tall enough to throw a shadow, would further indicate that this is not a lake but a swamp containing vegetation of at least some height. Such is the approach in photo-interpretation. Again, suppose that one wishes to identify a tree. From its dark tone one might guess that it was a conifer. From the shape of

its shadow and from the site where it grows, it might be further identified as a pine. From the peculiar star-shaped appearance of the tree when viewed from above in the stereoscopic image, an appearance caused by its layered branches, the tree could be positively identified as a white pine.

Advantages and Limitations

The recognition of site and the identification of species will illustrate both the advantages and limitations of aerial photographs. Forest site quality, the capacity of an area to produce tree growth, is basically a function of soil, topography, and local climate. Classifications of site such as are made on the ground in terms of indicator plants, growth rate, or the height that the average dominant tree will reach at a given age, can obviously not be made from aerial photographs. On the photographs, however, the photo-interpreter can evaluate the topographic location of an area, can frequently obtain some idea of the soil and underlying geologic formations, can recognize many of the tree species, and can estimate the ratio of tree height to crown diameter. From a synthesis of all these factors, he should be able to make a reasonably accurate diagnosis of the site. For instance, a level terrace in central New England, located in a river valley but definitely above the elevation of the water, with a light-colored soil indicating sand and an even texture indicating the absence of rock, and covered with a scattered growth of a pine reaching only into the middle-sized classes, would be readily identified as a pitch pine-white pine barren. Such an identification has a definite site connotation.

In identifying species of plants, one thinks at once of tree species, although it is possible to identify many shrubs, particularly where the shrubs occur in definite strata, as those in transition zones from deep swamp to dry land. During the period that aerial photographs of woodlands have been taken, it has been observed that many tree species and groups of tree species could be recognized from stereoscopic examination. The method of recognition is based in part upon a study of the pictorial elements of tone, texture, shadow pattern, shape, and dimension mentioned above. In large part, however, the problem of species identification is an ecological one. Unless the interpreter has an intimate knowledge of the groupings of species in relation to topography and site, he can make only limited identifications. In other words, he must have a thorough knowledge of the ecological relations of the forests in the specific region being studied.

Species identification from aerial photographs, then, is by no means simple. Few hard and fast rules can be laid down. Considerable training and experience are required. Yet, with this training and experience, much can be accomplished. If, for instance, the distribution of tree species in an area is clearly correlated with topography and site, a separation of softwoods and hardwoods alone on the aerial photographs, on the basis of tone together with the mapping of site quality, may suffice to give a clear picture of the distribution of species groups.

In New England, for example, most of the coniferous species can be recognized on modified infrared photographs taken during the summer season. Spruce registers in a darker tone than balsam fir, and the fir in a darker tone than the pines. Hemlock is still

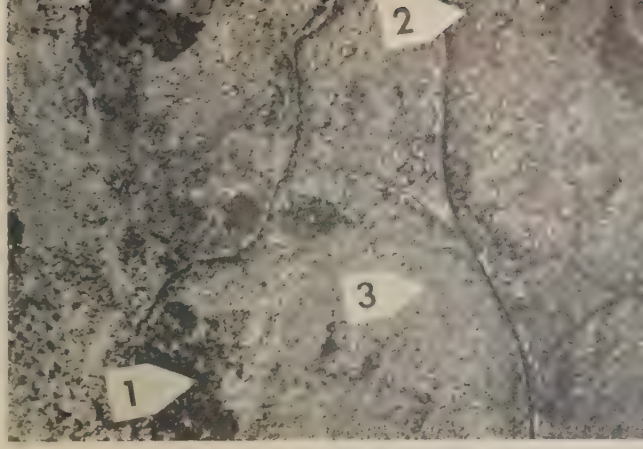


Figure 6. Normal infrared photograph showing strongly contrasting tones for conifers and broad-leaved species.

lighter, and tamarack is lightest of the conifers. Characteristic differences in shape, too, can be recognized. White spruce should never be confused with white pine because of the characteristic conical shape of the spruce crowns, even though the two species photograph in similar tones. The feathery, fine appearance of tamarack is quite distinctive from that of the other swamp species with which it grows. If the interpreter knows what species may be expected on a given habitat, he can usually obtain enough information from the tone, shadow pattern, and shape of the crown for a fairly specific identification. The problem of differentiating the hardwood, however, is much more difficult. Variations in the tones of hardwoods may be noted, but they are apt to be inconsistent and hard to tie down. Except where we can rely upon ecological rules, as for instance in identifying red maple in a characteristic red maple swamp, we can seldom make specific identifications of individual hardwood species.

Photographs are still a new and relatively untried tool in vegetation and land-use surveys. They constitute a permanent record, easily filed and readily obtainable, of the status of the land at the moment of photography. They contain a wealth of information not capable of being reduced to a map, words, or any other form of record. Whether detailed maps are to be prepared, or whether the photographs are to be used solely as a source of factual information gleaned through photo-interpretation, the photograph as a tool in vegetation and land-use surveys seems destined to become more and more useful and more and more generally used.

Figure 7. Modified infrared photograph showing good detail and good contrast between tones of different species.

Figure 8. Forest-type map of area photographed in Figures 5, 6, and 7. This map and the area photographs courtesy The Ronald Press Co. Aerial Photographs in Forestry, *by Stephen H. Spurr; copyright 1948.*

NOT only can aerial photographs, properly used, be valuable in improving knowledge of forest types, land conditions, etc., but much forest inventory information can be obtained as well. The following section of the paper deals with this particular problem.

USE IN FOREST INVENTORIES

Timber cruising is an indispensable but arduous part of the forester's job. By making the proper use of aerial photographic techniques, the amount of field work necessary in timber cruising can be greatly reduced, and accurate volumetric estimates may be prepared in a minimum of time and at a moderate cost. Ordinarily, the question is not whether aerial or ground techniques are preferable. Rather, the problem is how best to combine the two approaches so that they will complement each other.

In considering forest inventory, one normally thinks of volumetric and growth estimates. In much forest management, however, it is not timber volume that is primarily desired, but instead the acreage of each forest condition and of each site quality. Wherever acreage values are desired, the value of aerial photographs in supplying them is unquestioned. On the aerial photographs, stands can be classified by composition, density, and height. Stand maps can quickly and accurately be prepared, and the acreage of each condition class or other unit can be determined far more accurately and quickly from aerial photographs than from ground techniques.

It is when volume and diameter values are desired that the problem of how best to use aerial photographs becomes complicated. Obviously, much necessary information cannot be obtained directly from aerial photographs. For instance, the diameter of the stem cannot be seen, nor can the number of merchantable logs be counted. Information on the form of the stems, the amount of cull, and the rate of growth also cannot be obtained from aerial photographs.

Information Provided by Aerial Photographs

Actually, the amount of information regarding forest trees that may be obtained from normal-scale aerial photographs is strictly limited. Only six important variables characterizing the individual trees and stands can be determined or measured on even high quality pictures. First, many tree species, especially softwoods, may be identified in aerial photographs of the proper specifications. It should be noted, however, that many distinctions can be made only on the ground. Second, site quality can be classified on aerial photographs in terms of topographic location or species composition but not in direct terms of productive capacity of the soil. Third, tree heights may be measured. Fourth, crown diameters may be determined. Fifth, the percentage of growth stocking may be estimated in terms of crown closure. Finally, the number of dominant and co-dominant crowns in a given area may be counted.

In using aerial photographs in volumetric estimates, therefore, it must be known how precisely each of the above six variables may be evaluated. Then, it must be determined to what extent these variables are correlated with tree volume and tree diameter. Only then will one be in a position to know how much volumetric data can be obtained from the photographs and how much must be left for field determination. When this is known, it should be possible to design a timber cruise combining in the most effective fashion photographic analysis and measurements made on the ground.

First, let us consider the accuracy of measurements made on the photographs. Of the six variables listed above, two of them—species and site—are not numerical in nature. Many individual species, especially softwoods, can be identified on aerial photographs of the proper specifications. Many others, however, can only be lumped together in groups of species. Still others, especially many of the hardwoods, can seldom be positively identified. Obviously one can determine the volume on aerial photographs only of those species which can be recognized on the photographs. Thus, it might be possible to determine the volume of white pine in an area from photographic analysis only, but it would not be possible to list the volume of red oak as distinct from that of other oaks and hardwoods which have a similar appearance on the aerial photographs.

Broad site types can be delineated provided they can be classified in terms of topographic and moisture distinctions which are recognizable on aerial photographs. Topographic location may be listed as bottom, low-slope, mid-slope, high-slope, or top. In regard to moisture, the site can be said to be wet, moist, medium

dry, or very dry. Absolute elevation—the number of feet above sea level—can be estimated or even measured. Aspect—whether an area faces north, south, east, or west—can also be determined, as can the percentage of slope or grade. From such a classification, site quality can be determined on the photograph with considerable precision. It cannot be determined, however, in terms of site index, or indicator site-type.

Of the four variables concerning forest trees and stands that can be measured mathematically on aerial photographs, tree heights have attracted the most interest. The height of a tree on the photograph can be determined by three general methods. First, the displacement of the tree image in the single photograph can be measured and converted to tree height. Along the outer margins of the photograph, the tip of the tree will be displaced outward from the center more than the base and the tree will appear to be lying down, from which condition the actual displacement may be measured. The amount of displacement, though, is so small that the practical application of this method is limited to photographs taken with a wide-angle lens at a relatively low altitude and to conical trees, such as spruce and balsam fir, where both the tip and base of the tree can be seen and identified precisely on the displaced image.

If the angle of the sun at the time the photograph was taken is known and the length of the shadow can be measured, the height of the tree can easily be calculated. The shadow method has been extensively used in Canada for nearly 20 years and is rapid once the angle of the sun has been calculated. However, it is subject to a number of limitations. It will yield accurate tree height measurements without adjustment only when a shadow long enough to be measured falls upon an unobstructed level piece of ground. Errors are frequently introduced by the slope of the ground, by foliage or snow on the ground, and by the fact that only trees growing next to clearings can be measured by this method.

Of the three methods of height determination, the most accurate and the most satisfactory when it has once been mastered is the method of parallax differences. Basically, this is a method of measuring the apparent height of the tree as it appears in the stereoscopic image. With the aid of a parallax wedge or other parallax measuring device, a floating mark is placed in the stereoscopic image so that it appears to have the same position in the third dimension as the base of the tree. A reading is then taken. The floating mark is then raised so that it appears to have the same elevation in space as the top of the tree. Another reading is then taken and the difference between the two readings can be converted quickly into the height of the tree. With this method, the height of any tree on a high quality photograph of average scale, as 1:15,840, can be determined within about 1.5 m. (5 ft.). Ordinarily, the average error will be markedly less. When the heights of a number of trees are averaged, parallax measurements made on the aerial photographs frequently differ by less than 30 cm. (1 ft.) from measurements of tree heights made on the ground. The chief disadvantage of the parallax method is that it requires more training and much more experience than the shadow method. Once mastered, however, it will ordinarily be used almost to the exclusion of other methods.

Much more readily measured on the aerial photograph is the crown diameter. By the use of a micrometer wedge, or any other precise device for measuring horizontal distances on the aerial photographs, measurements of crown diameter can quickly and accurately be made. The experienced photo-interpreter should have no difficulty in classifying crowns into 0.9 m. (3-ft.) diameter classes, or at most into 1.5 m. (5-ft.) classes.

Stand density can be estimated in either of two ways: first, in terms of crown closure; and second, in the number of the tree crowns visible in the photograph. Both methods have their advantages. With but little practice crown closure can be estimated ocularly from aerial photographs studied under the stereoscope. Crown density scales, such as are used by the U. S. Forest Service, provide a standard of comparison. Crown closure is generally stated in terms of percentage of growth stocking, or as a decimal codifying this percentage. Thus, a density of 0.7 represents a stand in which 70 percent of the stand area is occupied by crowns of trees in the overstory.

Because the interpreter working with aerial photographs and a stereoscope can see the entire stand with literally a bird's-eye view, he can generally estimate stand density ocularly more accurately than it could be done on the ground. Estimates accurate to within

Figure 9. Mapping—triangulation network of mechanical templates. This photograph and Figure 13 courtesy Abrams Aerial Survey Corp.

Figure 10. The Rectoplanigraph is one of the more recent types of camera lucida.

10 percent should be consistently obtained with high-quality photographs of average scales.

By means of crown counts, it is possible to obtain a simple numerical value of density which is relatively free from the factor of personal judgment. The disadvantages of crown counts are the difficulty of getting an accurate count and the poor correlation that is apt to exist between this count and stand volume. The experienced interpreter, however, should be able to obtain values not more than 10 percent inaccurate.

It must be remembered that aerial measurements of tree heights, crown diameter, and crown counts are influenced by the fact that only what is caught on the film in a camera several miles above the ground can thereafter be evaluated. In every photograph there is a loss of detail attributable to the great distance between the camera and the ground, the vibration of the plane, the movement of the plane during the split second that the shutter is open, and the resolving power of the lens, film, and photographic paper. On a high-quality photograph, taken at a scale of 1:15,840, the accumulated effect of this loss of detail will erase from the pictorial image all objects less than about three feet in diameter. Corresponding losses will occur at other scales. This loss of resolution will affect all measurements of trees and stands made on the photograph. For example, only that portion of the tree whose crown is more than 0.9 m. (3 ft.) in diameter will be pictured on a photograph of an average scale. Consequently, tree heights measured on such photographs will be of only that portion of the tree up to the point where the crown diminishes to three feet in diameter. This height is called the "visible tree height," and an arbitrary correction, based upon the shape of the crown, must be added before it can be compared with measurements made from the ground. Similarly, the "visible crown diameter" will measure only that portion of the crown visible from directly above, with all isolated branches of small dimensions eliminated. Also, the "visible number of trees" will includ only those trees which have crowns of three feet or more in diameter visible from directly above. Once the implications of this lack of resolution are realized, however, measurements obtained from the photographs may be used with confidence in volumetric work.

Correlation of Information

Granted that the above variables can be measured with sufficient precision on aerial photographs, we must next ascertain their correlation with stem diameter and with volume. Stem diameter, or DBH, may be determined with fair precision from measurements of crown diameter because a high correlation exists in most cases between the two variables. Stem diameter values based upon crown diameter alone may be expected to be accurate within about 5 cm. (2 in.). A useful, rough rule-of-thumb is to assume that the stem diameter will be equivalent to one sixteenth of the crown diameter. This relationship is approximately true for many American species of the middle diameter classes. Tree height, as well as crown diameter, is correlated with stem diameter. A long tree with a given crown width will normally have a thicker stem than a short tree with the same crown width. Accurate determinations of stem diameter, therefore, should be based upon tree height measurement as well as upon crown diameter.

Determination of Volume

The determination of volume from aerial photographs, however, is much more difficult. In the case of a stand of very simple structure, such as an even-aged stand composed of a single species relatively free from defect, stand volume is closely related to tree height and crown closure. The volume of even-aged and homogeneous stands of such species as white pine and loblolly pine can therefore be determined with a fair amount of accuracy directly from the photographs. Furthermore, stand volume tables can be constructed in terms of visible total height and percentage of crown closure for use with aerial photographs.

The more complicated the stand structure becomes, however, the less accurate will be volume determinations made from the photographs because the correlation of volume with average stand height and average crown closure will be less. Nevertheless, even in such cases the volume of individual trees may frequently be determined from the photographs by means of tree volume tables constructed in terms of visible total height and visible crown diameter. If such tables are restricted to a given species and to a given site, variations in tree form will be largely taken into account and volume determinations may be approximately as accurate as those obtained from conventional volume tables based upon stem diameter and number of merchantable logs.

Actually, investigation has only begun on the possibilities of determining stand volume and tree volume directly from aerial photographs. The aerial approach

appears promising and will undoubtedly be further developed within the next few years. On the other hand, it is almost certain that variations in form, cull, stem diameter, and merchantable length will prove to be sufficiently uncorrelated with the variables measurable on the photographs, so that ground measurements will be required in most timber inventory work. Such will certainly be the case where the individual species cannot be recognized with certainty on the photographs. For instance, I cannot imagine ever obtaining an estimate from aerial photographs of the volume of a culled old-growth birch-beech-maple forest with such confidence that the estimate need not be checked from the ground.

Combined Aerial-Ground Techniques

If it is admitted that one cannot expect to obtain final volumetric estimates directly from the photographs, there arises a problem of combining photograph analysis and ground measurements into a single co-ordinated and efficient timber cruise. This problem can best be understood by considering what each approach has to offer.

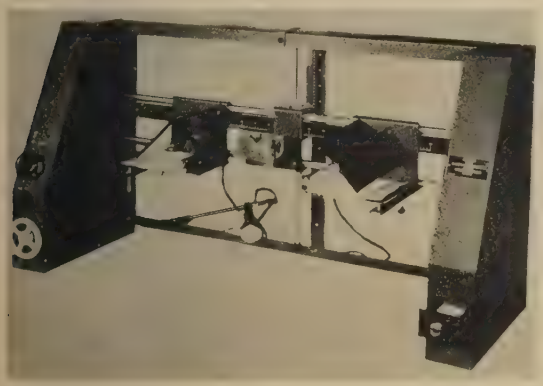


Figure 11. The Multiscope combines the mirror stereoscope and the camera lucida in a highly flexible form. Courtesy Northeastern Engineering, Inc.

The values of field measurements are obvious, because many more variables can be measured on the ground than from the photograph, and all measurements may be made with great precision. Aerial photographs, on the other hand, have two marked advantages in volume estimation. First, stand boundaries and stand areas may be accurately delineated and determined on photographs much more rapidly than they can be obtained by ground methods. This factor may more than counterbalance the lesser accuracy with which individual tree volumes may be estimated from the air. Second, samples and measurements may be obtained more rapidly on the photograph than on the ground. Statistical precision, therefore, may be obtained not by taking a limited number of carefully measured samples as in ground timber cruising, but by taking a large number of samples on the photographs measured with only moderate accuracy.

It would therefore appear that the most efficient timber cruise might well be one in which the forest was broken down into homogeneous areas by use of the aerial photographs, and the area of each homogeneous group determined from maps prepared from aerial photographs. The photographs could further be used to obtain a very large number of samples of forest condition, samples which would be measured with somewhat lesser accuracy than might be obtained on the ground. After this material had been obtained from the photographs, the remaining data would be collected on the ground. With the field crews efficiently planning their work from the photographs, they would sample on the ground each homogeneous unit that had previously been classified on the photographs. The intensity of their sample might well be determined by the apparent importance of each unit as determined from the unparalleled perspective of the stereoscopic image. In this ground sampling, the volume per acre of each homogeneous unit would be determined, as would be such measurements as stem diameter, stem quality, cull, and other values not obtainable on the photographs. By applying regular volume values derived from the ground to acreage values obtained from the aerial photographs, the final volume estimate would be obtained.

There are two major approaches by which photographic analysis and ground work may be combined; the stand approach, and the plot approach.

In the stand approach, a stand map is first prepared from the photographs. Ordinarily, homogeneous stand units are delineated and classified according to composition, density, and height. The acreage of each group of homogeneous stands is determined and its relative importance assessed. For instance, white pine stands which are fully stocked and are 80 feet high obviously have a high volume of timber and should be sampled intensely on the ground. Aspen and paper birch stands, on the other hand, which have come in after a burn and which have only attained a height of 30 feet obviously have little or no merchantable volume and need not be investigated in the field to any extent.

Once the stand map has been completed, the number of plots to be taken on the ground in each condition class is determined or calculated and the field parties are provided with a definite scheme of obtaining the desired number of plots in each class. For instance, cruise lines may be laid out on the stand map or the aerial photographs in such a way that approximately the right number of plots in each condition are

Figure 12. View of an aerial photogrammetry laboratory. Courtesy Harvard Forest.

to be taken. Another alternative might be to locate each plot on the photograph and have the field parties take the photographs with them in the field, orienting themselves by them and locating the plots on the ground as directed. In planning the field work, it is only necessary to make sure that the method of plot location will give an unbiased estimate of the per acre volume of each classification unit on the stand map. Per acre volumes obtained from the field are then multiplied by acreage values obtained from the stand map.

The plot approach of combining photographic and ground work is directly analogous to the line-plot system commonly used in timber cruising. Cruise lines are laid down upon the aerial photographs, or preferably upon the maps derived from the photographs. Plot centers are established and marked at intervals along these lines. The photo-interpreter then studies each plot in the stereoscopic image and either classifies it directly in terms of composition, height, crown diameter, and stand density or indirectly in terms of merchantability or stand volume. Since the plots are mechanically spaced, the proportion of plots that falls in any one class will suffice to determine the acreage of that class. The field parties then take the photographs out on the ground and relocate specified plots, checking the accuracy of the photo-interpreter and obtaining information needed to complete the survey. Data obtained in the field are thus used to correct and to amplify the estimates made upon the ground.

There are many possibilities of combining aerial and ground techniques. A number of such highly successful combinations have been used within the past few years in various parts of the United States and Canada. Few careful experimental checks have been made, but there appears little reason to doubt but that 50 to 90 percent of ground work required by conventional timber cruising can be eliminated by the proper use of aerial photographs without impairing in the slightest the accuracy of the timber cruise. When research is completed, it should be possible to increase accuracy and efficiency of combined aerial-ground techniques.

Figure 13. A simple lens-type stereoscope.

Use of Aerial Photographs in Inventory

We see, then, that major use of aerial photographs in inventory work will probably not be their direct use in volume estimation, but rather their use in controlling field work. We further see that aerial photographs are destined to be an indispensable tool in forest inventory for three major reasons.

First, stand maps developed from aerial photographs provide an inexpensive and accurate area control. The accuracy of any forest inventory can be increased if the acreages can be obtained rapidly and inexpensively from aerial photographs. It follows that less field work is necessary when photographs are used than would be necessary to obtain the same degree of accuracy without acreage control by photographs.

Second, stand maps developed from aerial photographs provide a highly effective means of stratifying a ground cruise. Plots may be located where they will make the maximum statistical contribution to the accuracy of the inventory estimate. Unnecessary plots may be eliminated. With a fewer number of total plots than would be required for an uncontrolled cruise of the same degree of accuracy, a heavier sample can be taken in the higher-volume, higher-value, and more variable types; while the intensity of sampling can be reduced in the lower-volume, lower-value, and more homogeneous types.

Third, the use of aerial photographs in the field permits the field parties to obtain their data with a maximum of efficiency. Nonproductive areas may be left out; swamps and other areas of bad going may be bypassed; and much compass and pacing work may be eliminated. With photographs, the field party can keep themselves constantly located and can choose the best route from one place to another. A word of caution should be added. In using aerial photographs to control field inventory work, it is important to remember that the photograph is not an accurate map. For this reason it is well to rely upon stand maps constructed from the photographs, rather than the photographs themselves, except where high-quality, low-tilt photographs of level terrain are available. In rough terrain, photographic images are displaced in large amounts and scale varies throughout. If photographs of such terrain are used directly in controlling inventory, it will be found that at the higher elevations areas are overestimated and sampling is overintensive, while at the lower elevations, areas are underestimated and sampling insufficient.

To sum up, whether the photographs should be used directly in volume estimation or used indirectly in connection with ground inventory depends upon a number of factors. It would appear that volume estimation directly from aerial photographs will prove rapid and efficient when (1) stand volume is closely correlated with photographic measurements, (2) applicable volume tables are available, and (3) relatively large scale, recent photographs of the proper specifications may be used. Under such conditions, ground checking is reduced to a minimum. Even where less satisfactory conditions prevail, however, photographs will constitute an essential tool in forest inventory because of their value in classifying the forest into homogeneous units, in stratifying the ground survey, in controlling movement of field parties, and in providing accurate area data.

Commodity Reports

With this issue Unasylva *begins a regular series of Commodity Reports dealing with the production, consumption, foreign trade, and market prospects for the principal forest products. It is planned that these reports will deal with the following commodities: sawn softwood, pulp and paper, pitprops, railway sleepers, hardwoods, fiberboards, and plywood. For each of these commodities* Unasylva *will issue at least one report in the course of each year but more frequent reviews will be carried for softwoods and for pulp and paper.*

Fiberboards

THE manufacture of fiberboard[1] arose out of attempts to utilize the wood waste resulting from paper manufacturing. The fiberboard industry, which originated in the United States of America about 1914, passed through a long development period and did not grow rapidly until after 1930. During the past ten years it has become strongly established in North America and in Northern Europe and has shown considerable expansion in other regions as well.

Manufacturers of fiberboard have found ways of utilizing wood not suitable for lumber or papermaking, such as the smaller trees, tops, etc. Many new factories are built adjacent to sawmills, pulpmills, and other wood-using industries so as to utilize wood which would otherwise be wasted. This is a positive step toward securing more complete wood utilization through the integration of wood-using industries.

While originally developed to utilize wood waste and inferior woods, where economic supplies of such raw materials are inadequate or for other reasons, the fiberboard industry may compete with other industries for its wood supplies.

The fiberboard industry has two great advantages over other wood-using industries: (1) it can utilize 95 percent of its raw materials and (2) it is not tied down to any definite species, shape, or condition of wood, as the fiber process treatment can be varied to suit any type of wood, provided the supply is large enough to make its use economical.

Plans for additional manufacturing facilities are being pushed ahead in many countries. Any advances in technology which will result in reducing the minimum economic capacity of manufacturing units below 8,000-10,000 tons per annum will undoubtedly lead to a big increase in the use of wood waste presently not contributing its full value to the world's economy. In addition, smaller plants will permit more countries to establish manufacturing facilities of their own.

Owing to the relatively cheap price of fiberboard, the low cost of installation, its insulation against cold and sound, its proven serviceability, and its growing number of uses, the demand for it is likely to continue in both producing and importing countries. Construction of new capacity in several European countries may not only satisfy local demands but may give rise to surpluses for export. However, some concern has been felt in Scandinavia that, in the near future, domestic production capacity may exceed local consumption requirements and the demands of importing countries. This concern reflects the difficulties importing countries may have in purchasing their requirements rather than any diminution in their needs.

Production in 1947

Most of the world's present productive capacity for fiberboard is centered in North America and Europe. In 1947, Canada and the United States produced more than seven tenths of the estimated world output of 1.7 million metric tons; European countries, two tenths; and other regions, the balance.

1947 Fiberboard Production
(*Thousand metric tons*)

Country	*Quantity*
United States	1,100
Sweden	235
Canada	124
Norway	36
Finland	30
United Kingdom	24
Australia	21
All others	130

The United States is the biggest fiberboard producer and production continues to increase, output in 1947 of 1.1 million metric tons being 25 percent greater than 1946 production and about double the prewar

[1] *Fiberboard*, as discussed in this report, refers to boards, sheets or rolls, used mainly in building, of which the chief raw material is wood. Raw materials may be in the form of pulpwood, wood pulp, waste paper, sawmill waste, screenings, etc. Gypsum board and plaster boards are excluded.

Hardboard (*Wallboard*) is a general term applied to fiberboard (hard and semihard) from 3 to 7 mm. (⅛ to ¼ inch) in thickness, used primarily in partitions, side walls, and other construction work.

Insulating board refers to insulating material in sheets or rolls usually from 8 to 20 mm. ($\frac{5}{16}$ to ¾ inch) in thickness with porous structure and good thermal and acoustic insulating properties. The fibers are sized and felted together to contain a large quantity of entrapped or "dead" air.

The statistics of some countries do not distinguish between fiberboards in which the chief raw material is wood and fiberboards where the chief raw material may be bagasse, straw, gypsum, etc., and thus not all figures are directly comparable.

figure. Production is in the hands of 15 companies with 16 plants, of which only two produce hardboard. Insulating board and hardboard are produced in the ratio of 5 to 1. In its manufacturing operations the industry employs approximately 10,000 employees. Existing plants are operating close to rated capacity and there is apparently no shortage of labor or raw material. American mills are relatively large, in relation to European standards.

Sweden, which first produced fiberboards in 1929, is the most important producer in Europe. Despite drought conditions which decreased water power, aggravated fuel shortages, and hampered production, the 1947 output of 235,000 tons represented a considerable improvement over the 1946 output of 218,000 tons and the 1939 output of 120,000 tons. There are said to be 14 plants with a total capacity of 250,000 tons. The Swedish factories are almost all situated on the northeast coast (Norrland) and are principally set up in conjunction with sawmills. Hardboards account for about 60 percent of total production.

Canadian production of fiberboards in 1947 of 124,000 tons was about 25 percent above 1946 and twice that of 1939. Canadian factories were operating practically at full capacity during 1947.

In Norway, the 1947 production of fiberboards was 36,000 tons, approximately 72 percent of productive capacity. Production of fiberboards in Norway has been increasing steadily since the first factory was established in 1932 with a capacity of 3,000 tons.

In Finland, 1947 production amounted to over 30,000 tons. The first fiberboard factory was built in 1930 and before the war was the largest of its kind in Europe, with a capacity of 30,000 tons. There are now seven mills with a total capacity of about 75,000 tons.

The United Kingdom produced about 24,000 tons in 1947 as against 23,000 tons in 1946, and 8,000 tons prewar when bagasse was the chief raw material.

In Italy, the 1947 output of fiberboard was 18,000 tons, primarily hardboard. This was a considerable increase over the 8,000 tons produced in 1946. Prewar production was negligible.

In Czechoslovakia, the latest reports of production are 16,000 tons a year. In part this has been accomplished by the establishment of a factory to use logging and sawmill waste, which formerly was burnt for fuel. It is said that it is competing for raw materials with plywood factories.

Fiberboard production in Belgium for 1947 was about 15,000 tons, an increase of almost 100 percent over 1946.

In Germany, the prewar output of fiberboards was manufactured by about 18 factories. Production in the western part of the country is now only a fraction of the prewar level of about 72,000 tons. One German fiberboard factory is being transferred as reparations to France.

In Denmark, 1947 fiberboard production was 11,000 tons as compared with 9,000 tons in 1946.

In Austria most of the plants suffered heavy war damage and production had practically come to a standstill in 1945. Manufacturing operations are slowly recovering. A new hardboard factory, which commenced operations in 1947, is using local raw material entirely. Total 1947 output reached 10,000 tons.

In Japan, 1947 fiberboard production was about 12,000 tons.

In Australia, the production of hardboard and insulating board in 1946 and 1947 was about 21,000 tons. Insulating boards are produced using bagasse as a raw material. Hardboard accounted for about 45 percent of production. The fiberboard industry in Australia has been working at capacity levels.

In New Zealand, the output of fiberboard fell somewhat below the capacity level of 11,000 tons as a result of electric power shortage. New Zealand has but one plant which up to this time produced only insulating board. Equipment for the manufacturing of hardboard has now been installed and is expected to be in operation in 1948.

There is a limited production of fiberboard in both France and Switzerland. Some attempts have been made to produce fiberboard in Argentina but with little success. There is one small factory in the Chaco region which produced some low-grade boards. In Peru over 400 tons of fiberboards were produced in 1943.

Information concerning the capacity and production of fiberboards in other parts of the world is not readily available. It is known that the U.S.S.R. produces fiberboard and that in the Far East there is a limited production for which the raw materials may be wood, bagasse, bamboo, straw, etc.

Consumption of Fiberboards

At present production lags behind demand. As indicated later, Sweden, Canada, the United States, Finland, and Norway are the major exporting countries, other producing areas having to supplement their domestic production by imports.

When the data for consumption are computed on a per caput basis, the large differences between countries in per caput consumption indicate the possibility of increased demands.

Present Consumption of Fiberboards

(*Kilograms per caput*)

Sweden	24
Norway	12
United States	8
Canada	8
Australia	2.5
United Kingdom	1.2
Union of South Africa	1.0
Argentina	0.3
Colombia	0.2
Japan	0.1
India	0.1

The growth in per caput consumption in recent years is indicated by the following figures:

Year	*Sweden*	*United States*	*Canada*
1939	12	1	3
1944	18	7	8
1946	24	[illegible]	8

Perhaps the chief reasons for the increased demand for fiberboards are that it has many uses and a favorable price compared with the high prices of competitive building materials. The fact that most factories throughout the world are now operating at, or near, capacity levels indicates that only lack of supplies would limit further increases in consumption, provided import restrictions, due to the world shortages of dollar exchange, could be lifted.

International Trade

Sweden, Canada, the United States, and Finland account for almost all fiberboard exports, with Sweden being by far the largest exporter. World exports have increased considerably in the postwar years as can be seen from the following figures for 1945, 1946, and 1947.

Fiberboard Exports
(*Metric tons*)

	1945	*1946*	*1947*
Sweden	15,400	68,800	75,000
Canada	43,100	38,000	18,000
United States	44,200	26,300	38,000
Finland	15,500	21,200	24,000
Norway	small	6,400	4,600
All other	4,500*	6,300*	5,600*
World Total	123,000*	167,000*	165,000*

* Estimated

Swedish exports in 1947 amounted to 32 percent of production, United States exports were 3 percent of production, and Canadian exports were equal to 15 percent of production.

In 1934 Swedish exports amounted to 41 percent of total production, in 1935 to 35 percent, and in 1936 to 30 percent of production. The prewar exports of the United States are estimated to have amounted to 20-25 percent of total production. Canadian exports in 1935 and 1936 accounted for from 35-40 percent of total production. These figures show that the domestic market in the principal exporting countries is absorbing a larger percentage of total production than in the prewar period.

Wallboards comprise about 65 percent of all Swedish exports, and about 32 percent of all United States exports. Canadian exports of wallboards are not recorded separately.

Principal Importing Countries
(*Metric tons*)

	1947	*1946*	*1945*
United Kingdom	35,000*	37,600	27,700
United States	30,000	25,000	26,500
Canada	19,000	11,700	9,700
Argentina	11,000*	...	...
Denmark	9,000*	12,000	9,900
Netherlands	9,000*	...	8,000
Philippine Republic	9,000*	7,300	900
Belgium	8,000*	...	6,300
Union of South Africa	8,000*	9,000†	2,700

* Estimated
... Not available
† Incomplete

While fiberboard exports originate primarily in Northern Europe and in North America, the markets for these exports are the industrialized countries in all regions of the world. The United Kingdom is the largest importer. Even though the United States is the largest producer of fiberboards, and in addition a large exporter, it provides the second largest import market for fiberboards. It is difficult to estimate the eventual size of import demand for fiberboards in many countries since at present the export supplies are not available and the lack of hard currency limits present demands.

Prices and Market Conditions

During the past few years, exports of fiberboard, although increasing, have been less than potential demand owing to exchange difficulties and governmental restrictions.

In 1945 Swedish internal market prices stood at about the same level as averages for previous years, although production costs had risen. Export prices also stood at 1943 level. In 1947, with the general rise in timber prices and costs of labor, prices for fiberboards were increased and Swedish prices are now higher than North American prices.

In the United Kingdom fiberboard imports for 1938, 1946, and 1947 were valued at £17, £33, and £38 respectively, per metric ton, representing an increase of 95 percent for 1946 and 120 percent for 1947 over 1938 prices.

Exports from the United States have increased in average value from about 80 dollars per ton in 1937-1939 to 120 dollars per ton in 1947, while the average Canadian export values for the same periods were 65 and 90 dollars per ton. The Canadian and U. S. prices noted above are not directly comparable because of the variation in composition of the material exported by the two countries.

Outlook for the Future

To meet the rising demand for fiberboard as a building material, especially for reconstruction to meet accumulated arrears in building and maintenance, many additions are being made to existing plants and new factories are being erected or planned. A number of these new factories will be in countries which have not previously manufactured fiberboard, and are being established as part of the drive toward complete utilization of wood and elimination of wastage through the proper integration of wood-using industries.

Dealers' stocks in the United States are reported to be in a better position than at any time in the past five years. As a result of this increasing capacity and the currency difficulties experienced by importing countries, some concern is felt in the Scandinavian countries that the ready market of the past will not be so favorable after this year and that some curtailment of production may be necessary. On the other hand, the advantages and ease of using fiberboard will doubtless result in continuing increased total world demands for this material, whether domestically produced or imported.

Additions and new installations under construction or planned have been reported for the following countries.

Australia. Additions to the existing hardboard plant should bring production to 13,000 metric tons in 1948 and a further increase in capacity to 20,000 tons is proposed.

Austria. Production is expected to reach 18,000 tons in 1948 and 33,000 tons by 1950.

Finland. When a new factory is completed and the other mills receive additional machinery necessary for making hardboard, the total capacity of the industry will reach 140,000 tons per year, of which about half is softboard and half hardboard.

France. German equipment is being transferred to Landes; furthermore a factory with an estimated capacity of 30,000 tons is being erected.

French Union. Preliminary plans for industrializa-

tion of the French territories in Africa propose the establishment of plants with capacities totaling 185,000 tons as follows: Ivory Coast—50,000; French Equatorial Africa—60,000; French Cameroun—75,000. However, immediate plans contemplate only one factory of 10,000 tons in Gaboon which is to use waste from logging, and from sawmilling and plywood-manufacturing operations.

Netherlands. A new factory is to produce 18,000 tons of hard and insulating fiberboard from straw, since wood supplies are not available.

New Zealand. A new installation for the production of hardboard should bring New Zealand's 1948 production to 20,000 tons.

Norway. New installations will bring Norway's productive capacity to 65,000 tons.

Sweden. Output for 1948 should exceed 250,000 tons and may approach 300,000 tons.

Switzerland. Plans to double Swiss output by 1949 have been prepared.

United Kingdom. Establishment of a factory in Scotland which will use low-grade material not suitable for lumber is in the planning stage.

U.S.S.R. At least two new factories were under construction in 1947 and should be in operation in 1948.

United States. Additions to old plants and new construction are expected to bring 1948 capacity and output close to 1.3 million tons.

Yugoslavia. Plans are being made to obtain a plant from Sweden capable of producing 6,000 tons of hardboards and 6,000 tons of insulating boards annually. At a later stage it is expected that the productive capacity for insulating boards will be doubled.

Pitwood

COAL production, which is of primary importance for the reconstruction of Europe, is very closely bound up with pitwood supplies. Although the total consumption of pitwood is approximately 30 million cubic meters of roundwood, international trade in this product only affects North America, which is an exporter, Europe, of which certain countries are importers and others exporters, and the Near East, which is definitely an importer.

The United States, whose production is a third of world production, Japan, South America, South Africa, Australia, and the Union of Soviet Socialist Republics produce their own pitwood. On the other hand, the mining centers of Western Europe depend essentially on imports, particularly on those from Scandinavia. The amounts involved in international trade vary between 5 and 7 million $m^3(r)$.

In the international market, pitwood represents a definite commodity. However, it has a wide range of sources; it can be obtained from any softwood timber in current use (*Pinus*, with the exception of Weymouth pine, and *Picea*), and from almost all the hard woods (except beech) which are to be found in Europe. Pitwood comes from young stands of softwood cut off at the root, from thinning fellings in fully grown hardwood or softwood forests, or from coppice cuttings at a relatively high rate of rotation. Softwood pit props are delivered barked, while hardwood pitprops may be delivered simply grooved. A practice peculiar to the Welsh mines should, however, be mentioned; they use unbarked rough sea pine (*Pinus pinaster*) obtained from France (Landes) or from Portugal.

Variations in the international pitwood trade are due to a number of causes: (1) they are the immediate consequence of fluctuations in the requirements of the mines; (2) they sometimes follow an increase in the national production of countries which are normally importers; and (3) they result, to a lesser degree, both from an improvement in the utilization of pitprops and from the use of steel sets and concrete galleries.

Before studying the pitwood market after the Second World War, particularly in 1947, and the prospective market, it is well to consider the evolution during the period from 1925 to 1938.

1925 to 1938

A summary of the position during this period can be obtained from Table 1, which shows the exports from the main exporting countries, and from Table 2, which shows the imports of the main importing

TABLE 1.—PITWOOD EXPORTS, 1925-1938

Country	1925-1929 Average	1930-1934 Average	1935-1938 Average
	(*Thousand cubic meters—solid volume*)		
Germany	496.80	658.80	26.75
Austria	94.00	56.20	73.50
Esthonia	112.40	92.40	96.25
Finland	1,420.40	1,463.20	1,888.50
France	[1]1,054.68	437.58	438.62
Latvia	391.40	316.60	351.00
Lithuania	5.40	3.00	8.00
Norway	69.40	34.20	33.50
Poland	1,232.20	250.20	183.00
Portugal	72.20	392.80	383.75
Sweden	539.00	355.20	194.25
Czechoslovakia	350.40	130.20	82.75
U.S.S.R.	395.60	1,393.40	1,457.00
TOTALS	6,213.88	5,583.78	5,216.87

[1]This figure also includes props for use other than in mines.

TABLE 2.—PITWOOD IMPORTS, 1925-1938

Country	1925-1929 Average	1930-1934 Average	1935-1938 Average
	(*Thousand cubic meters—solid volume*)		
Germany	653.00	194.80	143.50
Belgium-Luxemburg	733.20	709.20	630.50
Spain	99.60	67.20	6.00
France	570.80	636.40	169.00
Hungary	211.40	135.60	184.00
Netherlands	246.00	290.20	286.00
United Kingdom	2,770.40	2,449.40	2,845.75
Czechoslovakia	159.80	62.20	4.75
TOTALS	5,444.20	4,545.00	4,269.50

countries. These tables do not show Australian imports, which were quite considerable in 1938, the pitwood trade of the United States of America which can not be specifically identified, or imports by the Mediterranean countries.

Imports. The United Kingdom's imports amounted to more than half of the total and this situation prevailed throughout the whole period. There was a slight decline about 1932 but it did not last long. The Netherlands and Hungary kept up their imports, while France, Belgium, and Germany steadily decreased theirs. The decrease in German and Belgian imports resulted from increased domestic production, and not from a fall in coal production, whereas in 1936/1937 coal production in France and the United Kingdom fell slightly in comparison with the period 1925/1929.

Exports. Finland continued to be the chief supplier, particularly from 1935-1938. Its exports in 1937 amounted to more than 2,000,000 m^3(r). At that time Finland was supplying the greater part of the United Kingdom's pitwood. The U.S.S.R. entered the market in 1929, and from 1929 to 1937 its exports were at a fairly high level. Portugal's exports increased, and by the outbreak of war were approximately 300,000 m^3(r) a year. On the other hand, Poland's exports decreased. German exports, as from 1935, fell as a result of increased coal production and were insignificant in 1938. Swedish exports continued up to 1932/-1933 at the level of approximately 400,000 m^3(r), but then declined considerably owing to the use of potential pitwood timber in the cellulose industries. From 1925 to 1938, however, the pitwood market was adequately supplied, as a result of the large-scale exports from Finland and the U.S.S.R.

At the end of the period under review pitwood prices were comparatively favorable to producers. For example, in 1937 pitwood prices in Finland were £5 a fathom f.o.b. At that same time sawn timber was selling for £15-£16 per standard f.o.b.

1939 to 1946

During this period the countries of Europe which were occupied by the Germans or cut off from their normal suppliers had to exploit their own pitwood resources to the maximum. This was particularly the case in France, Belgium, the Netherlands, and Hungary. The United Kingdom, which had been one of the principal importing countries, was compelled to draw on its immature softwood plantations and considerably overcut its forests, even to the extent of total exhaustion in certain counties.

At the end of hostilities, Canada and Newfoundland sent considerable quantities of pitwood to the United Kingdom, and since that date Canada has kept up its large consignments of pitwood to Europe. And even the United States sent pitwood to Belgium in 1946. During the same period Finland and Sweden, owing to lack of coal, were forced to burn large quantities of pitwood.

After the cessation of hostilities, the character of Europe's pitwood market underwent a complete change. For example, Poland changed from an exporting country to an importing one after acquiring the Silesian mines. Canada, however, continued to send considerable supplies to the United Kingdom, Belgium, and the Netherlands. Finland and Sweden resumed delivery, while Portugal's exports consisted only of small shipments to England and North Africa. Germany became self-sufficient, partly on account of the loss of Silesia and partly as a result of the felling program drawn up by the Allied Authorities. Germany was even in a position to export certain quantities to France, Belgium, and the Netherlands, either in the form of dressed timber or of standing timber handed over on the spot for felling.

During this period after the cessation of hostilities, demand did not outrun supply. The importing countries found themselves compelled, owing to financial difficulties, to call upon their own national productive resources; and partial damage to mining plants resulted in the incomplete fulfilment of mining programs.

Position in 1947

After 1945, the question of European pitwood production and consumption was handled in London by the Timber Sub-Committee of the Emergency Economic Committee for Europe and the Production Division of the European Coal Organization. Since 1947, the work of these two bodies has been taken over by the FAO/ECE Timber Committee, which has made a study of production possibilities, and by the ECE Coal Committee, which has made recommendations for allocations.

The market position for 1947 was as follows: the production of European countries, supplemented by imports from Canada, made it possible to cover the requirements of European collieries. On the whole, supplies to the mines actually exceeded consumption, as stocks at the mines on 31 December 1947 were greater than on 1 January 1947.

Trade. The principal exporting countries were Finland, with 1,367,000 m^3(r) and Canada, with 701,000 m^3(r). The United Kingdom headed the list of importing countries with 2,883,000 m^3(r).

Production. Tables 3, 4, and 5, taken from the Statistical Bulletin of the FAO/ECE Timber Committee,

Table 3.—Pitwood Production, 1946 and 1947

Country	1946	1947
	(Thousand cubic meters—solid volume)	
Austria	172	212
Belgium	600	650
Czechoslovakia	405	351
Finland	(1,227)	(1,338)
France	[1]3,164	[2]2,562
Germany		
—U.K./U.S. Zone	1,825	2,082
—French Zone	710	1,532
—U.S.S.R. Zone	.....	(692)
Hungary	162	197
Ireland	13	11
Italy	160	320
Luxemburg	77	65
Netherlands	44	30
Norway	76	(96)
Poland	1,400	1,500
Sweden	250	220
Switzerland	50	15
Turkey	237	146
United Kingdom	1,138	572
Canada	(863)	(870)
Totals	12,573	13,461

Note: The figures in parentheses relate, not to production, but to exports.
[1]Of this production, 48,000 m^3 (r) comes from fellings in Germany.
[2]Of this production, 2,000 m^3 (r) comes from fellings in Germany.

TABLE 4.—PITWOOD PURCHASES IN 1946 AND 1947

Purchased in:	Purchases notified by: Total		Belgium		France		Netherlands		Poland		United Kingdom		Other Countries	
	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947
	Thousand cubic meters—solid volume of roundwood													
Austria	17.5	—	—	—	—	—	—	—	—	—	—	—	17.5	
Czechoslovakia	21.5		—	—	—	—	—	—	—	—	—	—	21.5	—
Finland	668.1	993.7	—	20.0	6.8	8.0	2.5	40.0	—	—	658.8	925.7	—	—
Germany	244.0	335.4	—	—	27.2	53.0	121.0	61.0	—	—	95.4	204.4	0.4	17.0
Rumania	1.2	—	—	—	—	—	—	—	—	—	—	—	1.2	—
Sweden	245.4	189.7	—	—	—	—	62.0	100.0	—	—	183.4	89.7	—	—
Other European countries	175.3	143.2	—	37.0	31.8	10.0	30.0	12.0	—	—	107.7	80.5	5.8	3.7
U.S.S.R.	101.9	92.7	—	—	—	—	—	—	—	—	101.9	92.7	—	—
Canada	736.9	831.7	—	—	—	—	—	—	—	—	736.9	831.7		
Countries not specified	728.0	148.0	628.0	—	—	—	—	—	100.0	60.0	—	—	—	88.0
TOTAL PURCHASES	[1]2,939.8	[1]2,734.4	[2]628.0	57.0	65.8	71.0	215.5	213.0	100.0	60.0	1,884.1	2,225.7	46.4	108.7
TOTAL IMPORTS	3,030.0	3,701.0	628.0	360.0	66.0	71.0	216	213		60	2,053	2,883	61	114

[1]Includes deliveries in respect to purchases in previous years.
[2]The assumed basis is: Purchases = Imports.

TABLE 5.—PITWOOD SALES FOR 1946 AND 1947

Sold to:	Sales notified by: Total		Austria		Czecho-slovakia		Finland		Germany		Sweden		Other European Countries		Canada	
	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947
	Thousand cubic meters—solid volume of roundwood															
Belgium	353.2	364.6	—	—	—	—	334.5	302.2	—	—	—	—	18.7	62.4	—	—
Denmark	0.9		—	—	—	—		—	—	—	—	—	0.9	—	—	—
France	8.9	15.6	—	—	—	—	8.9	15.6	—	—	—	—	—	—	—	—
Greece	1.9	6.0	—	—	—	—	—	—	—	—	—		1.9	6.0		
Hungary	189.3	24.7	162.0	—	27.3	24.7	—	—	—	—	—	—	—	—	—	—
Italy		3.5	—	—	—	3.5	—	—	—	—	—	—	—	—	—	—
Netherlands	152.5	137.4	—	—	—	—	35.7	84.7	—	—	96.4	50.6	20.4	2.1	—	
United Kingdom	2,003.6	2,373.7					758.2	927.7	[1]137.0	[1]292.2	133.2	143.8	135.7	308.3	839.5	701.7
Other European countries	0.1	41.8				4.8		37.0					0.1			
Middle East and North Africa	2.1	9.1	—	—	—	—	—	—	—	—	—	—	2.1	9.1	—	—
Countries not specified		42.0		42.0	—	—			—	—	—	—	—	—	—	—
TOTAL SALES	[2]2,712.5	[2]3,018.4	[3]162.0	42.0	27.3	33.0	1,137.3	1,367.2	[1]137.0	[1]292.2	229.6	194.4	179.8	387.9	839.5	701.7
TOTAL EXPORTS	2,758	3,306.0	12.0	42.0	27.0	33.0	1,253	1,610	137	292	230	194	259	418	840	717

[1]These figures only represent British Zone sales to the United Kingdom.
[2]Includes consignments in respect of sales in previous years.
[3]The assumed basis is: Sales = Exports.

show pitwood production, sales, and purchases for the main countries for 1947. Coal production and pitwood consumption figures for specified countries are given in Table 6. The pitwood consumption figures also include timber used in brown coal mining.

According to the ECE Coal Committee, the estimates in respect of participating countries both for coal production and pitwood consumption have generally proved to be correct during 1947.

TABLE 6.—COAL PRODUCTION AND PITWOOD CONSUMPTION IN 1947

Country	Hard Coal Production (excluding opencast)	Total Pitwood Consumption (including that used in brown coal mines)
	Thousand m.t.	*Thousand m³ (r)*
Austria	178	150
Belgium	24,390	1,021
Czechoslovakia	16,305	541
France	45,235	2,488
Italy	1,222	214
Netherlands	10,104	223
Poland	59,130	1,709
Turkey	3,897	191
United Kingdom	192,433	2,626
Bizone (Germany)	71,128	2,398
Saar	10,485	401

National production goals in the various countries, taken as a whole, were exceeded by 8 percent, although France reached only 89 percent of her estimated production. On the other hand, Belgium, with 650,000 m³(r), and the United Kingdom, with 572,000 m³(r), reached 165 percent and 170 percent respectively of their estimated figures.

Estimated imports were exceeded by 19 percent, and the United Kingdom, thanks to additional supplies from Finland, U.S.S.R., the Soviet Zone of Germany, and Canada received 47 percent more than was estimated, the Netherlands bought more Finnish pitwood than had been originally planned, but other countries did not entirely complete their import programs.

Thus, the main importing countries were able to build up larger stocks by the end of 1947 than had been expected, owing to larger availabilities and a slight overestimate of pitwood consumption requirements for the year.

Prices. During the postwar period, pitwood prices rose sharply. Average prices (c.i.f.) in England for pitwood from Canada, Finland, and Sweden were as follows:

Country	1938	1946	1947	1947 Price Index
	£ s. d.	£ s. d.	£ s. d.	(1938=100)
Canada	1 10 5	4 19 10	5 15 3	378
Finland	1 14 3	3 16 8	4 12 5	270
Sweden	1 11 2	...	4 6 4	277

In 1947 timber experts, meeting at Paris in connection with the Committee of European Economic Cooperation, used an f.o.b. price of $12.7 per cubic meter in estimating the cost of the pitwood import program.

1948 Situation

The supply position at the beginning of 1948 was better than that in 1947. The stock position at the mines on 1 January 1948 in comparison with that on 1 January 1947 is shown in Table 7.

Table 7.—Stocks in Mines

Country	1947 (As at 1 January)	1948 (As at 1 January)
	(Thousand m^3 (r))	
Austria	.....	144
Belgium	747	333
Czechoslovakia	406	121
France	1,181	2,006
Italy	20	82
Netherlands	130	[1]833
Poland	245	6,081
Turkey	129	16
United Kingdom	1,485	887
Saar	80	215
Bizone (Germany)	[1]1,122	1,318
Totals	5,545	126

[1]Including stock build up, viz. as at 1 January 1948 666,725 m

Some countries possess relatively large stocks of pitwood either dressed at the felling areas or held by producers and retailers, for example:

Belgium	163,000 m^3(r)
Bizone (Germany)	666,725 m^3(r)
Czechoslovakia	215,000 m^3(r)
Finland	613,000 m^3(r)
France	717,000 m^3(r)

The present stock position is relatively favorable, but what are the prospects for the future?

Since coal is of such importance for the economic reconstruction of Europe, it is expected that everything possible will be done to fulfill coal production programs in 1948. The demand for pitwood will therefore be considerable. It has been possible to estimate the demand on the basis of the average pitwood consumption factors per ton of coal produced (varying according to the country concerned), due allowance being made for the fact that it will not be possible to resort to metallic sets owing to the shortage of steel. The factors adopted are indicated in Table 8. This analysis of requirements has been made by the Coal Committee of the ECE.

Furthermore, the FAO/ECE Timber Committee has studied, for the year 1948, the anticipated domestic pitwood production of all European countries, except the U.S.S.R., and export availabilities in Canada and the U.S.S.R.

These studies have shown that the total pitwood requirements of Austria, Belgium, Czechoslovakia, France, Greece, Ireland, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, Turkey,

Table 8.—Pitwood Consumption per Ton of Coal Produced

Country	Coefficient
	(Cubic meters per metric ton)
Austria	0.05901
Belgium	0.04186
Czechoslovakia	0.02006
France	0.05500
Italy	0.03357
Netherlands	0.02207
Poland	0.02850
Turkey	0.04892
United Kingdom	0.01365
Saar	0.03825
Bizone (Germany)	0.03371

United Kingdom, and the three Western Zones of Germany amounted to 14,844,000 m^3(r), while their pitwood production totaled only 14,355,000 m^3(r), thus leaving a deficit of 489,000 m^3(r). Import needs within these countries amount to 4,877,000 m^3(r), while export availabilities, including added Canadian and Soviet exports, amount to 4,388,000 m^3(r). The 1948 expected deficit is therefore not large since it represents only 3 percent of total estimated consumption. It could easily be covered by present stocks.

Estimated exports include 760,000 m^3 (r) from Canada and 1,100,000 m^3 (r) from Finland, while imports of 2,528,000 m^3 (r) and 500,000 m^3 (r) are forecast for the United Kingdom and Belgium respectively. The United Kingdom, taking 52 percent of total imports, thus remains the largest importer.

This situation could be improved further if Sweden, which has declared an availability of 145,000 m^3 (r), could increase this to 300,000 m^3 (r), as it intends to do if its coal requirements are met. Yugoslavia also might be prepared to export 80,000 m^3 (r) of pitwood if its special equipment needs were met. There is likewise reason to hope that Finland, which has declared 1,100,000 m^3 (r) for export, will exceed this figure in view of its large-scale exports in previous years. Finally, there is a possibility that certain Eastern European countries will enter the market and so help to close the gap in pitwood supplies, and that Austria and Czechoslovakia will have export availabilities.

On the basis of the data at present available the ECE Coal Division has recommended the allocations shown in Table 9.

Although the reported stock position as of January 1948 is fairly satisfactory on the whole, it should not be forgotten that the Ruhr collieries finished the year 1947 with very low stocks, and it might be thought necessary to devote part of the German export availabilities to building up the Ruhr stocks. In this connection it should be noted that mine pithead stocks of pitprops on 1 January 1948 were dangerously low, totaling only 166,000 m^3 (r). However, at the same date cut timber stocks amounting to 660,000 m^3 (r) were available. Nevertheless, if the production plan calling for 86,000,000 metric tons of coal is carried through, 4,154,000 m^3 (r) of pitwood will be required. Assuming that pitwood imports from the Soviet Zone of Germany will amount to 500,000 m^3 (r) and those from the French Zone to 42,000 m^3 (r), and allowing for exports of 100,000 m^3 (r) through cutting concessions, production in the Bizone should reach 3,712,000 m^3 (r).

The Bizone authorities are known to have fixed fellings for 1948 at 30,000,000 m^3 (r) of unbarked tim-

ber of all kinds. In theory, therefore, these fellings should make it possible to obtain the 3,712,000 m³ (r) of pitwood required. If, however, there is also a big demand for pulpwood and fuelwood, the rebuilding of normal stocks may prove somewhat difficult.

What has just been said does not apply to the mines of the Saar, which are now integrated in French economy and are supplied by the Saar itself and by imports from the French Occupation Zone (400,000 m³ (r) in 1947). Stocks on 1 January 1948 amounted to 83,000 m³ (r), representing about three months' production.

The over-all situation is therefore satisfactory. Certain factors which may alter somewhat the appearance of the pitwood market must however be pointed out.

In the Scandinavian countries pulpwood competes very keenly with pitwood. This competition is inevitable. It results, on the one hand, from perfectly integrated forest exploitation and, on the other, from the considerable demand for cellulose. Indeed, in Sweden, where there are abundant standing resources available, the presence of a large number of pulping plants favors the production of pulpwood to the detriment of pitwood. Pulpwood at present finds a very favorable outlet in North America, thereby making available the hard currency necessary to Sweden.

Great Britain is to buy from Canada 760,000 m³ (r) of pitwood and will thus need to have the necessary currenly at its command; otherwise it will be forced to seek additional supplies from the European market, which might then show a net deficit.

Finally, owing to the insufficient coal supplies in certain countries, especially in Germany, pitwood is sometimes used for heating in great urban centers. However, this situation is offset in other countries by a better coal position which makes it possible to obtain pitwood from plantations of copsewood normally cut for firewood. This can be particularly valuable for mines using a high percentage of small timber.

Prospects for 1949 to 1951

The situation has been examined by the Coal Committee of the Economic Commission for Europe, and statistics have been compiled showing the coal production, pitwood consumption, import requirements, and export availabilities for the principal European countries. An examination of these statistics reveals an anticipated deficit amounting to 5 percent of requirements in 1949 and increasing to 9 percent in 1951. This increase in the deficit is in great measure due to an increase of coal production in the European countries under review from 530,660,000 tons in 1939 to 606,780,000 tons in 1951—an increase of approximately 13 percent—while pitwood production in the same countries, including imports from Canada and the Soviet Union, rises from 14,036,000 m³ to 15,368,000 m³ (r)—an increase of only 9 percent. It seems that in 1951 the deficit in pitwood will be 1,431,000 m³ (r).

Therefore, if pulpwood offers much competition with pitprops for the available roundwood supplies, it will be difficult to overcome the deficit. Moreover, those countries which have overcut during the war will be inclined to reduce their cutting.

It is, however, difficult to make prophecies at the present time. The situation may in fact be completely changed by the appearance on the market of large quantities of pitwood from the U.S.S.R. or, on the other hand, by better utilization of pitwood in modernized mines and by the use of steel sets as steel production increases. However that may be, in present circumstances, it will be exports from Scandinavia which will regulate the pitwood market in the economic area under review.

Table 9.—Pitwood: Bilateral Trade Agreements and Recommended Allocations, 1948[1]

	Exporting Country	Importing Country: Belgium	France	Saar	French North Africa	Hungary	Italy	Netherlands	Poland	Turkey	United Kingdom	U.K./U.S. Zone of Germany	Total
		(Thousand cubic meters—solid volume)											
Bilateral Trade Agreements	Austria					66							66
	Canada										760		760
	Czechoslovakia	10				21	9						40
	France	50									150		200
	French Zone of Germany		[2]200	650								200	1,050
	U.K./U.S. Zone of Germany	15						15					30
	U.S.S.R. and Soviet Zone of Germany								100		250	500	850
	Ireland										9		9
	Luxemburg	30						50					80
	Portugal				15						80		95
	Switzerland		10										10
	Yugoslavia					12				10			22
	Total	105	210	650	15	99	9	65	100	10	1,249	700	3,212
Allocations Recommended	Sweden							34		25	200		259
	Norway										67		67
	Finland												
	Firm Avail.	280						68		30	720		1,098
	Add. Poss. Avail.	20								10	80		110
	Total	300						102		65	1,067		1,534
	Grand Total	405	210	650	15	99	9	167	100	75	2,316	700	4,746

Note: The balance of the exports available from Finland and Sweden, recommended for allocation to Netherlands and France (E/ECE/COAL/PSC/3 Rev. 1), have been renounced by those countries.

[1]As compiled by the ECE Coal Committee, Production Subcommittee, Pitwood Working Party, for their meeting on 23 August 1948.

[2]From the French cutting concession.

The Work of FAO

FAO's New Director-General

NORRIS E. DODD, new Director-General of the Food and Agriculture Organization of the United Nations, is a farmer, an agricultural administrator, and a student of international affairs.

Mr. Dodd, Undersecretary of Agriculture of the United States of America since April 1946, was named by acclamation of the FAO Conference in a special session at Washington, 14 April. He has succeeded the Organization's first Director-General, Sir John Boyd Orr, of Scotland.

On the occasion of his successor's election, Sir John said, "It is difficult to get nations to co-operate on a political level. The world is torn by political strife. But through FAO the nations *are* co-operating. Here round the Council table representatives of governments are not talking about war, not thinking about war. They are planning for the greatest movement that will make for peace. . . ."

The new Director-General has been prominently identified with FAO since 1946. He led the United States delegation at the FAO Copenhagen Conference (1946) and the Geneva Conference (1947), and he represented his country on the Preparatory Commission on World Food Proposals (October 1946-January 1947). He has been the United States representative at both sessions (November 1947 and April 1948) of the recently organized Council of FAO.

Before his appointment as Undersecretary of Agriculture, Mr. Dodd was director of the Field Service Branch of the Department's Production and Marketing Administration from August 1945, and before that he served as chief of the Agricultural Adjustment Agency from June 1943. This agency had the major responsibility for food production during the war.

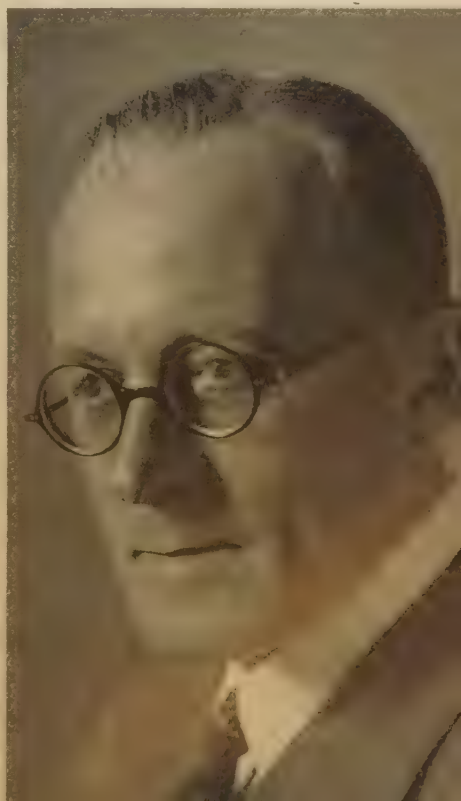
Mr. Dodd, who still operates his Oregon grain and livestock ranch, came to Washington in the fall of 1938 as assistant director of the AAA's Western Division, which was responsible for administering a wide variety of commodity programs in 13 western states. In March 1939 he was made Western Division Director, a position he held for the next four years.

Mr. Dodd's service with the AAA programs goes back to their earliest operations in 1933. His first position was the chairmanship of his County AAA Wheat Committee, and later he was made State chairman of the Oregon Corn-Hog Board of Review. In 1936 he was named chairman of the Oregon State Agricultural Conservation Committee. Two years later he was selected to serve as the AAA's field representative in the Western States, a position which he held until he was advanced to the assistant directorship.

Mr. Dodd was born 20 July 1879, in Chickasaw County, Iowa, and settled in Oregon in 1900. For many years he has stood as a moral force in the development of the food and agriculture policies that underlie FAO philosophy. He has been a leader in promoting rational programs to stabilize agricultural prices in order to bring to the world a better and more secure food supply.

Norris E. Dodd, Director-General of the Food and Agriculture Organization of the United Nations.

Sir Herbert Broadley, the Organization's new Deputy Director-General.



The New Deputy Director-General

SIR HERBERT BROADLEY, Deputy Secretary of the United Kingdom Ministry of Food, has been named Deputy Director-General of FAO.

Sir Herbert, an administrator of wide experience, has succeeded Mr. Noble Clark, who served as interim Deputy Director-General on loan to FAO from the University of Wisconsin.

Sir Herbert has had long association with FAO, going back to the first Annual Conference at Quebec in 1945, when he was a member of the United Kingdom delegation. He was chairman of the Committee on Conservation and Expansion of Supplies at the Special Meeting on Urgent Food Problems held in Washington in 1946. At the 1946 Copenhagen Conference he was chairman of the World Food Board Committee.

Sir Herbert was born 23 November 1892. After attending the University of London, he entered the British Civil Service in 1912 and continued in that service until 1926, the last six years with the Board of Trade. He resigned in 1926 to join an advertising firm as director. At the outbreak of the war in 1939 he returned to government service with the Ministry of Food.

Sir Herbert was made a Knight of the British Empire in 1947.

Meetings

Standing Advisory Committee on Forestry and Forest Products

The Standing Advisory Committee on Forestry and Forest Products met at the headquarters of the Organization in Washington from 31 May to 5 June, under the chairmanship of Lyle F. Watts, Chief of the United States Forest Service.

After electing H. G. Champion, Professor of Forestry at Oxford University, as rapporteur, the Committee reviewed the activities of the Forestry and Forest Products Division for the past year and considered the Director's report on the work accomplished. Individual members of the Division's staff reported on the various projects with which they had been especially concerned. In completing its review of these activities, the Committee expressed its satisfaction with the work accomplished by the Division with the limited resources at its disposal.

The Committee next reviewed the program of work proposed by the Director for 1948/49 and its financial implications. It discussed separately the work of the Forestry Branch and of the Forest Products Branch, programs for Asia and the Far East, Africa, the Middle East, and Latin America, and the regional work of the European Working Group.

Considerable discussion took place regarding the arrangements and agenda for the Third World Forestry Congress, which is being organized by the government of Finland for July 1949 at Helsinki. Professor Osara of Finland was present by invitation when these arrangements were considered. The Committee recognized that the chief purpose of the Congress should be to bring together practicing technical and research foresters, and that discussions should be concentrated on a limited number of outstanding problems rather than on broad matters of policy, for which the Annual FAO Conference might be the more suitable occasion.

The Committee also reviewed the activities and progress of its technical subcommittees E. I. Kotok and T. Gill attended the sessions at which the work of the Research and Unexploited Forests Subcommittees was considered and reported on the activities which they had directed as chairmen. In view of changed circumstances in the composition of the Standing Advisory Committee, the Committee proposed that the title of these subsidiary bodies should be changed to technical committees or special committees. The membership of these committees should be varied to suit the special subjects under consideration at any time.

In forwarding its recommendations to the Director-General in a confidential report, the Committee expressed the view that the execution of the proposed 1948/49 program, in which it concurred, reflected a very judicious selection of the most urgent tasks from the many that the Division should be undertaking. It was confident that the execution of this program would result in steady progress along lines developing from past activities and in certain new fields. It was recognized, however, that shortage of staff and funds has inevitably resulted in the postponement of several activities which call urgently for attention.

Members of the Committee attending the meeting, in addition to those already mentioned, were: A. Fjelstad, Delegate of the Royal Norwegian Government on Agricultural Affairs; S. C. Lee, Chief of the Department of Forestry, Nanking; D. A. MacDonald, Acting Dominion Forester, Canada; H. Mark, Brooklyn Polytechnic Institute, New York; E. Saari, Forestry Department, University of Helsinki; P. de Souza, Ministry of Agriculture and Forestry, Rio de Janeiro.

B. Dufay (France), G. Cerf (Belgium), and H. Winkelmann (Switzerland), were unable to be present.

European Commission on Forestry and Forest Products

The first session of the European Commission on Forestry and Forest Products was held at Geneva from 6 to 12 July 1948 with delegates from 19 countries present. In an opening statement the Director of FAO's Division of Forestry and Forest Products pointed out that the Commission would be primarily concerned with meeting long-term problems, but would work closely with the FAO/ECE Timber Committee. Its principal objective should be self-sufficiency for the continent of Europe as regards timber. This would entail co-ordination of national forest policies to secure increased production and more efficient utilization. The Director suggested that FAO, on the request of interested governments, might make recommendations to appropriate international agencies in cases where external aid was required.

On the proposal of the Chairman, Mr. B. Dufay, Director-general of Waters and Forests, France, the Commission drew up a tentative balance sheet of timber resources and requirements, from which three general conclusions were drawn, namely, the necessity for better utilization, the need to increase the productivity of existing forests by better techniques, and the urgent requirement to increase the area of European productive forests.

Statements of national forest policies, presented by each of the European countries represented, brought out in detail the extensive overcutting and great destruction or damage resulting from the war or its consequences. The Commission was encouraged by the extent to which remedial measures are being applied and the importance attached to the development of proper forest policies in the postwar national plans of European governments.

The Commission set up four committees: inventory and statistics, increased production, expansion of productive forests, and Mediterranean problems. The committee reports were adopted by the Commission. The recommendation of the Mediterranean problems committee for the establishment of a special subcommission on Mediterranean problems was acted upon immediately and the Italian delegation was requested to organize the first meeting to be held in Rome during the fall of 1948.

Advance copies of FAO reports, *Forest Resources of the World* and *Yearbook of Forest Products Statistics*, were made available. These reports facilitated the work of the Commission by providing a great quantity of data not otherwise available.

FAO/ECE Timber Committee

The third session of the FAO/ECE Timber Committee was held at Geneva from 28 June to 2 July 1948 under the Chairmanship of Mr. B. Dufay, Director-general of Waters and Forests, France. Forty-seven delegates from 19 countries were present. Primary attention was directed to the increasing shortage of supplies of sawn softwood which will attain serious proportions in 1949/1950. The effective import demand is expected to increase while at the same time normal export availabilities will be considerably less. The gap for 1949 was estimated by the Committee at approximately one million standards, due, in part, to increased diversion of roundwood supplies to pulp and, in part, to an anticipated sharp decline in exports from the Bizone of Germany.

The Committee gave some consideration to the competition of pulpwood for roundwood supplies usable for both sawn timber and pulpwood. Attention was also drawn to the fact that the ECE Committee on Industry and Materials had invited the Executive Secretary to consult with the Timber Committee and with FAO regarding a proposed study of the European wood pulp situation, in view of the close interrelationship between sawn timber, pitprops, pulp, and other forest products. It in-

vited the Executive Secretary of ECE and the Director-General of FAO to investigate the matter and present a report to the Committee at a later stage.

The Committee expressed great interest in the joint FAO/ECE project on economies in timber consumption. Undertaken in co-operation with FAO and the Housing Subcommittee of ECE, this study should promote the more intelligent use of timber by prevention of waste in the forest and in manufacturing operations and by progressive standardization in housing construction methods.

Further consideration was given to proposals for International Bank credits to enable exporting countries to increase production and exports of softwood and pitprops by substantial amounts in 1949 and 1950. Tentative agreement was reached on revised proposals which involve the submission of additional details as to equipment requirements and purchase possibilities. The Committee decided that a further discussion would be necessary when this information had been received, and agreed not to adjourn, but to recess, and reconvene as soon as the necessary material had been assembled.

Technical Committee on Wood Chemistry

Second Meeting

On 14 and 15 May the FAO Technical Committee on Wood Chemistry held its second meeting in the Palais des Nations in Geneva. Chairman of the meeting was Herman Mark, Director, Polymer Research Institute, Polytechnic Institute of Brooklyn. The Conference was attended by delegates of 9 European countries.

Austria. R. Scheuble, Director, Forestry Research Institute, Mariabrunn, and A. von Wacek, Director, Division of Organic Wood Chemistry, Chemical Institute, Vienna.

Belgium. E. Castagne, Director, Chemical Research Laboratory, Ministry of Colonies, Tervuren, and A. Gillet, Dean, University of Liege.

Finland. B. R. Nyberg, Director, Central Laboratories, Helsinki, and O. Ant-Wuorinen, Director, Chemical Laboratories, State Institute of Technical Research, Helsinki.

France. J. Campredon, Director, National Wood Institute, Paris; E. W. Fauconeau, Director, Pine Institute, Faculty of Science, Bordeaux; and A. C. Villiere, Chief, Industrial Chemistry Division, National Wood Institute, Paris.

Italy. G. Centola, Director, Pulp Research Station, Milan.

Netherlands. J. L. Bienfait, Director, Forest Products Division, Central Institute for Testing Materials, Delft.

Norway. S. Samuelson, Director, Paper Research Institute, Oslo.

Sweden. Eric Haegglund, Director, Central Laboratories of the Pulp Industry, Stockholm, and E. Waldenstrom, Director, Swedish Pulp Company, Stockholm.

Switzerland. A. Kung, Pulp Factory, Attisholz.

Secretary of the meeting was D. Roy Cameron, Chief, FAO Forestry Working Group, Geneva.

The chief purpose of the meeting was to familiarize the European delegates with the discussions and conversations which had taken place in America during the past few years in conjunction with the establishment and possible activities of this Committee and to obtain their views about the desirability of such a committee and about its functions. The Chairman, therefore, gave a brief report on the meetings in New York in February and Appleton in September 1947, and submitted the ideas and suggestions of the American wood chemists to their European colleagues. There followed an animated discussion amongst all members, the focal point of which was whether, in view of the many existing organizations, a committee of this kind is at all necessary or desirable. Many good arguments were offered pro and con and, after a careful analysis of the entire situation, the members reached the conclusion that the establishment and maintenance of a technical committee on wood chemistry appears to be desirable. In conclusion, the Chairman summarized the essential points which might usefully form the basis of the committee's work, as follows: (a) advising FAO on technical projects and studies in the field of wood chemistry which FAO is requested to undertake; (b) collection of information concerning laboratory and library facilities; (c) promotion of rapid, world-wide distribution of scientific literature; (d) study of the possibilities of initiating an abstracting service in the field of wood chemistry; and (e) informal exchange of information on various methods of research.

The Chairman's summary of the general lines which the activities of the Committee might usefully follow was approved. It was also noted that it seemed generally agreed that the Committee should meet about once a year.

The Committee then heard the reports of the various delegates which essentially described for each country, (a) the available facilities for research and development work in the entire field of wood chemistry, and (b) the specific problems to be faced in the field of wood chemistry and chemical wood utilization.

These reports were discussed during the meeting; they presented a very impressive picture of the wealth and complexity of the problems which face FAO and its Forestry and Forest Products Division.

Third Meeting

The Third Meeting of the Committee on Wood Chemistry was convened on 14 and 15 August in Cleveland, Wisconsin. Besides the American delegates, outstanding European wood chemists from Sweden, Holland, and Great Britain attended.

On the agenda for the meeting were such important items as educational problems and the exchange of technicians, tree farms in the United States, a world plan for forestry combines, and the Chemistry World Congress in Stockholm.

Committee on Mechanical Wood Technology

The FAO Committee on Mechanical Wood Technology held an important meeting at the Palais des Nations at Geneva, Switzerland, 8 to 12 June. Mr. Jean Campredon, France, was Chairman.

The Conference was attended by delegates of 12 countries.

Argentina. O. Planella, Chief, Division of Forestry Products, Institute of Technology SIC, Buenos Aires.

Australia. K. L. Cooper, Officer in charge, Timber Mechanics Section, Division of Forest Products, C.S.I.R., Australia.

Austria. G. Giannelia, Secretary-General of the Austrian Society of Forest Products Research, Vienna; E. Melan, Professor, Institute of Technology of the University of Vienna; and M. Schlager, Austrian Association for Wood Construction, Linz.

Belgium. J. A. G. Fouarge, Forestry Laboratory, Institute of Agriculture, Gembloux.

Czechoslovakia. A Travnik, Forest Products Research Institute, Bratislava.

Finland. F. E. Siimes, State Technical Research Institute of Finland, Helsinki.

France. J. Campredon, Chief, Central Wood Research Laboratory, Paris.

Italy. G. Giordano, Professor of Wood Technology at the Forestry Institute of the University of Florence.

Netherlands. J. L. Bienfait, Director of the Forest Products Research Laboratory, Central Institute for Testing Materials, Delft.

Switzerland. H. Kuhne, Section Chief, Federal Laboratories for Testing Materials.

United Kingdom. J. Latham, Officer in Charge of Timber Mechanics, Forest Products Research Laboratory, Department of Scientific and Industrial Research, Princes Risborough.

United States of America. L. J. Markwardt, Assistant Director, Forest Products Laboratory, Madison, Wisconsin.

The agenda of the meeting called for consideration of three broad problems of international interest in the field of forest products as follows:

(1) International Standardization of Methods for Testing Small Clear Specimens,

(2) Wood Utilization Studies,

(3) Combined Forestry and Utilization Problems Relating to the Development of Forest Resources.

The deliberations on International Standardization of Methods of Testing Small Clear Specimens included (a) a discussion of the general underlying principles; (b) consideration of detailed procedures for five principal tests, namely compression parallel to grain, tension parallel to grain, shear parallel to grain, static bending, and impact bending; (c) review of a second group of tests comprising tension perpendicular to grain, compression perpendicular to grain, cleavage, and hardness; and (d) a report on the standardization of methods of testing fiberboards.

The Committee adopted a number of resolutions covering the question of preferred sizes for test material and various detailed requirements for the compression-parallel-to-grain test, and the static-bending and impact-bending tests. Because of the many factors and details involved, the entire time was taken up with problems relating to the standardization of methods of testing, and it was accordingly not possible to cover the other items on the agenda.

A draft report was presented to the Committee summarizing certain present and recommended practices relating to tests of structural fiberboards. It was pointed out that this draft incorporated also the results of some recent research studies relating to size and form of specimen and testing speeds. The delegates were invited to submit comments and suggestions on the draft entitled "Methods of Test for Evaluating the Properties of Building Boards" to Mr. L. J. Markwardt at the U. S. Forest Products Laboratory, Madison, Wisconsin, with the thought that these will be summarized for further consideration by the Committee.

In order to carry forward still further the work of the Committee with respect to methods of testing, assignments were made for a number of special studies, on which a report is to be made to the Committee at some forthcoming meeting. The specific study assignments are as follows:

(a) *General requirements on factors related to strength:*

(Mr. Cooper, Australia)

i. The calibration and use of test equipment.

ii. Methods for determining the moisture content and the distribution thereof in the samples.

iii. The interrelation between moisture content, specific gravity, and other physical and mechanical properties.

iv. The swelling and shrinking properties and the influence thereof on the behavior of wood.

v. Methods of presenting data.

(b) *Tension parallel to grain:*

(Mr. Kuehne, Switzerland)

i. To study the methods and procedures used in the tension-parallel-to-grain test, particularly with respect to the influence on test results of such factors as size and proportion of test piece, stress distribution, and density.

ii. To prepare a summary of various methods and procedures as furnished by the delegates for distribution to the Committee membership and for later discussion.

iii. To make such further studies as are necessary to compare better the various methods used, as a guide for future progress in standardization.

(c) *Shear parallel to grain:*

(Mr. Markwardt, U.S.A.)

To assemble information on different shear test methods and procedures used, with special consideration to the cube as a form of test specimen; to compare results as far as possible and summarize procedures and findings as the basis for a study report to the Committee.

(d) *Impact bending:*

(Mr. Markwardt, U.S.A.)

To prepare a summary of the various test methods and procedures used; to secure data from other members on the effect of notched specimens in the Izod test for correlation with other data; and to summarize procedures and findings as the basis for a study report to the Committee.

(e) *Group Two Tests (Tension perpendicular to grain, compression perpendicular to grain, cleavage, and hardness):*

(Mr. Bienfait, Holland)

To report on the standardization of all the tests mentioned in the second group in the General Agenda, June 1948, for the discussion of which time was lacking. The item, abrasion, if possible, should be added to the subjects already mentioned.

(f) *Fiberboards:*

(Mr. Markwardt, U.S.A.)

Subsequent to the presentation of the special report on methods of testing fiberboards (FPL mimeograph R1712, entitled "Methods of Test for Evaluating the Properties of Building Boards"), the members are requested to submit comments and suggestions to Mr. Markwardt for analysis and summarization in connection with a subsequent report for consideration point by point by the Committee at the next meeting. Study should be made also of additional methods, including puncture resistance and behavior when subjected to high humidities.

(g) *Plywood, laminated wood, and modified wood:*

(Mr. Siimes, Finland)

To summarize methods used in the testing on plywoods, laminated wood, and modified wood.

(h) *Structural grading of timber:*

(Mr. Siimes, Finland)

Because of the importance of structural grading, to make a summary of present grades and grading methods, as the basis for detailed discussion at the forthcoming meeting.

United Nations Economic Commissions

ECAFE

The Economic Commission for Asia and the Far East completed a twelve-day session at Ootacamund, India, on 12 June. The Commission's planning stage is now over and the action stage has been reached. The meeting appealed to advanced industrial countries to supply capital goods and basic materials to countries in Asia and the Far East to help their industrial rehabilitation. Countries of the ECAFE region are requested to specify their short-term needs and long-term development plans, and give a clear definition of their policies in order to promote conditions favorable to investment and enterprise in the region. The Commission endorsed the convening by FAO of an international timber conference in that region to be held early in 1949, to stimulate interregional trade and seek solutions to common forestry problems.

ECLA

The Economic Commission for Latin America held its first session in June at Santiago, Chile. ECLA is concerned with 150 million people living in 20 countries which cover an area of 20.2 million km^2. These people have adapted themselves to every extreme of climate. The soil and natural resources of Latin America offer the main challenge. Prosperity is possible, but Latin America is desperately poor in what is needed to extract, process, and distribute its riches to the rest of the world. There is little or no traditional policy of coordination among the various political units of Latin America. Most of the republics developed their trade not with each other but with the outside world.

ECLA is to undertake first an economic survey of Latin America, determining the main economic characteristics, the region's problems and their relationship with world economic conditions. In the course of this survey, FAO will be able to co-operate in examination of many fields recommended for study by the Latin-American Conference on Forestry and Forest Products, held in Brazil in April of this year.

Forestry Survey in Asia and the Pacific Area

In order to lay the groundwork for the forthcoming Forestry and Timber Utilization Conference in Asia and the Pacific Area, an officer of the Forestry and Forest Products Division spent almost five months touring Pakistan, India, Burma, Siam, China, the Philippines, Indo-China, Malaya, Indonesia, Australia, and New Zealand. In addition to conferring with government officials, heads of research institutions, and forest school faculty members, he visited logging operations, sawmills, plywood plants, and other wood-using industries, and spoke to both exporters and importers as well as producers of timber The existence in some countries of urgent remands for lumber, fuelwood, and other wood products on the one hand, and, on the other, countries with almost untapped virgin timber; the fine development of research in several countries and a keen interest for research in others; the existence of a number of good forestry schools which could help train students from other countries; and especially the excellent work of many experienced foresters which could be greatly expanded: all of these things stress the importance of the forthcoming conference. A more complete report will be given in a later issue of Unasylva.

News of the World

The items appearing here are condensed selections of news thought to be of interest to readers of UNASYLVA. *They are grouped alphabetically by countries under headings currently used by the Division of Forestry and Forest Products for reference purposes. The Editor will be glad to receive direct from readers authenticated items of interest and of news value for this part of the review.*

General

AUSTRALIA

A report from New South Wales, Australia, indicates that the placement of immigrants from the Baltic States of Europe on Government forestry projects is proceeding satisfactorily. The forestry officers directly involved have been impressed by the appearance, intelligence, and co-operative spirit exhibited by the new workers. The immigrants have an opportunity to accumulate cash reserves while learning the language and customs of their new country. The Baltic workers have already made their presence felt with the result that urgent forest projects have been speeded up and new ones commenced.

AUSTRIA

In late years conditions in Austria have been very detrimental to the forest. As it is barely possible to keep up sustained supplies of timber and wood products for the Austrian economy, there is an absolute necessity to utilize forest resources and stocks in the most rational and economic manner.

Austria, realizing that intensive research is the only answer to the problem, has decided to give special attention to this project.

Prior to 1938, timber research was by no means neglected in Austria. There were experts of international repute working in this field. However, activities were not co-ordinated or centralized in a single body. An Austrian committee for timber problems already existed before 1938 as a part of the Austrian Timber Control Board, but its activity was directed towards an increase of timber consumption rather than toward a rational and economic utilization of timber resources. The reason for this policy was the difficulty encountered by the Austrian timber industry in disposing of its products. Today conditions are entirely different. Not even the most urgent timber requirements of the Austrian economy can be satisfied. The same situation exists with regard to timber exports, which are of the greatest importance for the country's balance of trade.

For these reasons it is essential to find the best methods of wood utilization so as to obtain the best results with the minimum of material. Intensive research and effective help for all institutions engaged in such research are of absolute necessity.

Austria possesses a number of internationally famous institutions which are active in the field of wood utilization and research. However, until now, there has been no efficient co-ordination between these bodies. Recognizing that under present conditions overlapping must be avoided at all costs, the Austrian Society for Wood Research has been founded after many years' preparation. The aim of this society is the integration of all institutions and organizations connected with wood research.

All well-known Austrian experts are collaborating with the new society. As a result of the great interest expressed by competent Austrian authorities, a forum has been created which, it is hoped, will be in a position to co-ordinate all activities in the field of wood research. However, according to tradition, Austria also intends to co-operate in this field in the international sphere. Close collaboration should be carried on with all countries and should include the exchange of knowledge and experience.

FRANCE

An announcement has been made that the Faculty of Sciences of the University of Strasbourg has just created a regular public course, which is still the only one of this kind given in France, on the subject of pedological and phytosociological cartography. This course is intended for persons such as agricultural experts, forestry specialists, etc., who may need such information for their professional work and particularly for those who would like to participate in the work of making a phytosociological map; some pages of this map with a scale of 1:2,000 have been published recently. They cover various regions of France and will serve as a model.

NORWAY

The Norwegian Forestry Society (Det Norske Skogsselskap) and the Norwegian Foresters Association (Norsk Forstmannsforening) are both celebrating their 50-year anniversary in 1948. Both have had a great influence on the progress of forestry in Norway during their period of existence. The president of the Forestry Society is Mr. Jørgen Mathiesen and Mr. Nils Ihlen is the president of the Foresters Association.

SWEDEN

Among the films to be produced under the 1948 program of the United Nations Information Division is one on "Timber." Although this film will be made by one of the leading documentary producers in Sweden, it will not be about that country only but will be international in both content and point of view.

UNITED KINGDOM

The 23rd annual report of the Imperial Forestry Institute, University of Oxford, for 1947, states that it could be claimed that practical work and tours were fully back to the prewar standards, and had, in fact, been strengthened in certain respects, notably on the engineering and utilization side. There were 44 students attending courses, and all senior students took part in a series of open discussions on a wide range of forestry topics.

Courses included silviculture, soil ecology, forest botany, forest pathology, forest entomology, mensuration and management, wood structure, forest economics, British forest law, Colonial forestry administration, forest engineering, surveying, etc.

The Education Secretary of the U.K. Timber Development Association announces that the new syllabus for commercial subjects has now been approved by the Joint Council of the Association of Principals of Technical Institutes and Association of Technical Institutions.

The syllabus for the revised three-year course is as follows:

First Year: Structure of softwood trade in the U.K. — trade methods and customs — units of sale — payment of terms; railway classification; structure of hardwood trade in the U.K., etc. (as above).

Second Year: Trade documents; Contracts "Albion," "Uniform," Pacific Coast, Russian, Eastern Canadian; doors, plywood, and hardwood contracts; c.i.f. reselling. Comparison between them and detailed discussion of clauses (including T.T.F. insurance clauses).

Third Year: Shipping: Charter parties (detailed discussion of clauses); bills of lading; "documents"; marine insurance and policies; claims; arbitration; customs of various ports; marketing. Trade organization (employers' and employees'). Relation of size to use (e.g., carcassing, flooring, wharfing, docking, area customs). Elements of commercial law and practice.

UNITED STATES OF AMERICA

A trip has just been made to the United States by a young French forestry worker. This trip was the outcome of a first agreement concluded between the Chief of the U. S Forestry Service and the director of the Ecole nationale des Eaux et Forêts in Nancy. The original purpose was to have an "exchange" of two American war veteran forestry workers for young French officers graduated from the School. The duration of these visits, which were first scheduled

for 1947, had been originally fixed at two months; each government was committed to defray the expenses for the main travel of its nationals and interior travel and current expenses of its guests.

The two American forestry workers made their study trip on schedule in 1948. They stayed at the Nancy School and made the field trips with each of the School's two graduating classes (Central France, Landes, Jura, Vosges, and Alps). The French government sent only one officer to the United States in 1948. He has just completed a field trip for study and information in the most interesting forest areas, particularly the entire Pacific coast, the South, and the Northeast.

It is the intention of these two countries to pursue and develop such exchanges in the future.

Silviculture and Management

Belgium

It is pointed out that the "typographic bostrychid," *Ips typographus*, recently appeared in the spruce stands of the Belgian Ardennes. The exceptional drought in 1947 apparently caused the rapid spread of this damaging beetle in Western Germany, Eifel, the Black Forest, Bavaria, Switzerland, and Czechoslovakia. The exploitation of the growing stock, which deteriorated over the entire European continent during the war, has only been resumed slowly and still proceeds at a slow pace; this also has encouraged the increase of bark beetles.

Canada

Since the summer of 1946, Canada has organized a vast survey on the subject of forestry regeneration which is still under way at the present time. This survey is conducted on 20,500 plots, 8,000 of which were prepared in 1946 and 12,500 in 1947. The results are rather disturbing. On the surface areas exploited the regrowth of conifers in eastern provinces is satisfactory, but a substitution of Balsam fir, *Abies balsamea*, for other species, and particularly for the valuable white pine, is taking place. On the other hand, regrowth is becoming poorer and poorer in the Provinces of Manitoba and Saskatchewan, though somewhat better in Alberta. However, on those lands which have been subjected to fire following exploitation, it is extremely slow everywhere, except in Alberta, where the land is planted with Lodgepole pine, *Pinus contorta*. The survey has not yet covered British Columbia.

In order to extract seeds from air-dried cones of coniferous trees, the Departmental Station of Angus (Ontario) is now using an ingenious machine in which heat is derived from infrared lamps. The cones are moved along over two successive aluminum traveling bands in which holes have been punched. The bands are exposed to the radiation of a series of lamps, the direction and height of which, above the traveling bands, can be easily regulated. The seeds expelled fall through the holes of the bands and are thus immediately withdrawn from the effects of heat. Between the two bands the cones are plunged into water, and the effect of this bath is to ensure a more complete dislocation of the scales and a surer extraction of the seeds on the second traveling band. The machine is small in size (5.80 m. x 0.90 m. x 1.80 m.) and the traveling bands are superimposed one above the other. Its capacity is 130 liters per hour; the time necessary for the total treatment of a cone is 4 hours instead of the 50 required by the usual methods of treatment. The machine is driven by a ¼ horsepower motor. Lastly, the temperature control is perfect.

China

Until 1945, the *Metasequoia* was known only in the fossil state. In February of that year, Chinese explorers discovered stands of this tree in a secluded valley of Central China. Seeds derived from these stands have been shipped to England and the United States, where they will be subjected to germination tests.

France

The occurrence of pine rust, *Melampsora pinitroquum*, which is frequently found among young stands of forest pines, *Pinus sylvestris*, has been noted in the forests of the Landes; this disease had not yet attacked the pinaster, *Pinus pinaster*. Pine rust attacks the yearly sprouts of young seedlings in the humid zones, kills the less vigorous among them, and deforms the others. The secondary host is the aspen or the white poplar. Combating the disease directly by spraying the plants with copper sulphate can only be done on a small scale. The procedure to be followed, therefore, is to eliminate aspens and, in the future, to avoid mixing pinasters with aspen and white poplar trees or bringing plantations of these species into close proximity with stands of pinasters.

Greece

War damage to the forests has been severe; the timber on 25 percent of the wooded area has been destroyed. Only three fifths of these damaged forests is capable of natural regeneration. Foresters must, therefore, limit themselves to the artificial reforestation of the remaining two fifths, and they will not be able to continue their ambitious reforestation program started before the war. Of the total area of Greece, 15 percent, or 1.918 million hectares, is covered with forests. The main species are *Abies cephalonica* (229,000 hectares), *Pinus halepensis* and *Pinus brutia* (420,000 hectares), and beech, *Fagus*, (193,000 hectares). Forty-three percent of the forests are coppice, 26.5 percent are coppice with standards, and 30 percent are high forests.

Morocco

The country's reforestation plan covers a period of 25 years and includes 2 million hectares of arid soil and poor or cut-over forest lands. The 500 km. of forest roads existing in 1925 have now been increased to 3,000 km. A forestry school at Ifrane will give forest rangers their initial schooling.

Sweden

The Forestry Week Exhibition which took place recently in Stockholm was extremely successful and made possible the public exhibition of many innovations, both in the field of forestry, strictly speaking, and in forestry exploitation and the wood industries. Attention was particularly attracted by a "calculating microscope" which makes it possible to determine rapidly the number and thickness of the annual rings starting from the core and thus to examine 500 tree sections per hour Also of note was the research work which has been actively pursued with regard to improved varieties of forest trees and species of rapid growth, particularly as regards the crossing of Canadian and Swedish aspens. In a lecture, Professor M. Naslund stated that, considering the results obtained in the general census begun in 1938, it was advisable that cutting be reduced by 30 percent in the northern part of the country for a period of approximately 20 years, while the rate of fellings might remain unchanged in the central portion. In the South, on the contrary, it would be possible to increase the rate of cutting. The application of the recommended program would make it possible to increase the yield of the Swedish forests gradually up to 50 percent within 80 years.

United States of America

It is reported that in the State of Wisconsin the area covered by white pine, *Pinus strobus*, the most highly appreciated species in that region, is expanding. It is said to have increased by 100,000 acres (40,000 ha.) in the last ten years, up to the present area of 430,000 acres (174,000 ha.) under second generation stands which are dense enough to ensure protection automatically against rust, *Cronartium ribicola*. The tendency is towards still further expansion, since most of the stands are now attaining cone-bearing age. This result is due no doubt to the active protection given to this species through close co operation between private holders, the State, and various services of the Federal Government, through eradication of *Ribes*.

Although there have been numerous instances of the introduction of American tree species into Europe, it is only rarely that one comes across reports of the results obtained from the introduction of European species on American soil. However, many early ironmasters of Pennsylvania, following the example set by the large landowners of England, imported European trees for decorative purposes. In a recent article, mention is made of a plantation of European larch trees, *Larix decidua*, from 25 to 70 years of age, covering 1.20 hectares, still alive near the city of Warriors Mark in central Pennsylvania. Measurements were taken in the autumn of 1947 on this plantation where there still remain 200 trees, either in pure tree clumps or mixed with many native broadleaved trees. The average diameter of the trees was found to be approximately 35 cm. and the average height 22 m. The most striking fact was the poor development of the tree-tops which indicates that this species requires considerable spacing from a very early age. Their growth is comparable to that of the native conifers. Finally, natural regeneration is taking place and

the stands could be restocked if the young seedlings were protected from competition with native species and given adequate light.

Aspen, *Populus tremuloides*, is found in Utah in vast and sometimes entirely pure stands, the resources of which are estimated to be about 20 million cords (51 million m^3 (r)) of standing timber. It is used in that State for many purposes, namely, for fences, telegraph poles, pitprops, packaging, etc., and its excellent mechanical qualities would justify a still more extensive utilization. It is incorrect to state that the majority of aspen trees of large dimension are suffering from decay. One of the most recent uses of aspen is for the manufacture of wood wool, called "excelsior" For the manufacture of this product, the aspens most in demand are those approximately 30 cm. in diameter, barked and chopped into logs 43 cm. in length on the spot. Research work is being carried on to discover the best management methods to be applied to these stands on a sustained yield basis. The difficulty is that for this purpose it is necessary to start early and that there is no market at present for small size logs. Forest regrowth requires a clear felling and prohibition of pasturing of flocks in the area until such time as the terminal buds are high enough to be beyond the reach of grazing livestock. The best method of exploitation is to cut 60 percent of the volume, leaving all trees 25 cm. or less in diameter, and then to return to the same forest area 10 years later in order to cut the remaining trees. This method of cutting greatly improves the quality of the pasture land below the aspen stand, without damaging the forest.

Wood Conversion

Algiers

The first new esparto pulp and paper mill to be erected during the last 25 years is now being built in Algiers The pulping equipment is being supplied by Celdecor and the scheme includes Celdecor-Pomilio continuous digestion and gas chlorination and the Kamyr bleaching system. The output of the mill will include 24 tons daily of fine esparto straw papers and 18 tons daily of strong wrapping paper, for which straw will be used as raw material. All the Celdecor equipment for this should be delivered by the end of 1948. Some of the Kamyr equipment will be manufactured in the United Kingdom and some in the Union of South Africa. It is reported that the Celdecor-Pomilio process is being considered for installation in several mills in India. Two more installations are reported being installed in France and consideration is also being given to this process in the Netherlands.

Australia

The new sawmill and pulpwood-preparation plant of the Associated Pulp and Paper Mills of Tasmania will be equipped with machinery manufactured by Canadian Sumner Iron Works of Vancouver, British Columbia. Negotiations for this order, which have been in progress since the summer of 1947, were brought to a successful conclusion early this year. Determining factors in the choice of Canadian Sumner machinery were the critical U. S dollar shortage and the more advantageous tariff on Canadian-built machinery imported into Australia. In addition to building the machinery, the engineering staff of Canadian Sumner was charged with the responsibility of preparing plans for the new sawmill and pulpwood preparation plant. The machinery to be built at the Vancouver plant includes a Bellingham-type hydraulic whole log barker which, tests have shown, is efficient in the removal of eucalyptus bark. Structural steel will come from Australian plants, and pumps and motors will probably be shipped from England. Other machinery from the Sumner shops will include log hauls and log deck machinery, log turners, log loaders, two 8-foot bandmills, two air-operated sawmill carriages with shot gun feed, one slabbage chipper, and one whole log chipper with other incidental machinery. The machinery will be supplied to Paper Makers Proprietary Ltd., a subsidiary of the Associated Pulp and Paper Mills, and shipped to their operations at Burnie, in Northwest Tasmania on Emu Bay facing Bass Strait. Sir Walter Massey-Greene is managing director, with headquarters at Melbourne, while Harry B. Somerset is general manager at Burnie, Tasmania.

Finland

A Finnish company has started continuous cooking of cellulose. This process is a goal towards which the cellulose experts have striven for long and which now can be regarded as reached. So far only the sulphate method has been applied, and production on a technical scale has been carried out at a pilot plant. The application of this method to sulphite cooking is also being initiated. Four mills for utilization of the sulphate method are already under construction in Italy, France, and Sweden, and more mills are planned. Thanks to the new method, the cellulose digester does not need to be emptied and refilled for the following batch. Refilling and emptying take place successively during the process which thus does not need to be interrupted. The economic consequences are considerable, as the operating costs are reduced.

On 14 April 1948 a new fiberboard mill was put into operation at Pihlava, Finland. Present output of insulating boards is 10,000 tons; however, it is expected to begin the production of semi-hardboard and hardboard some time in 1949, at which time the total capacity of the mill will reach 25,000 tons Work on the mill began in the autumn in 1946 and construction in the spring of 1947. The raw material will be sawmill waste.

India

The first British rayon plant for India was shipped a short time ago from England for the Travancore Rayon Co., which has a paid-up capital of approximately £1,250,000 and is expected to be in operation by the end of the year. The Travancore plant is being equipped with the latest British rayon production development, the "Nelson" process, which spins, washes, dries, and winds in on continuous sequence. It is simpler and less costly than other methods.

Sweden

A new method of producing cellulose from straw has been worked out in Sweden. The problems involved have been thoroughly studied by experts, who have also critically examined the methods so far used in Sweden and abroad for producing pulp from raw materials like straw, bagasse, bamboo, etc., with a view to eliminating their weak points. A method has been found which is considered both technically and economically satisfactory. After thorough laboratory experiments, large-scale trials were arranged at some cellulose mills in Sweden and abroad, and the results obtained met very strict demands The method gives a high yield from the raw material used, and the paper produced from the pulp is quite comparable in purity and strength with paper made from wood cellulose. The production costs are considerably lower than in the methods so far used for making bleached cellulose from wheat straw. Negotiations have been opened with several European and American countries regarding building new mills, or reconstructing old mills in order to use the new process.

Union of South Africa

The Swedish firm of Bolidens Gruvaktiebolag, in conjunction with the Forest Products Institute, South Africa, has recently carried out successfully in South Africa antitermite tests on fiberboards. The tests show that untreated fiberboards attacked by the termite are completely destroyed within six months, while boards which have been impregnated with a solution of arsenic last as long as five years. The extra cost of these specially treated boards is not unduly heavy, the price for ⅛ in. (0.3 cm.) fiberboards being £1 12s. 6d. per 1,000 square ft (93 m^2).

United Kingdom

During the past two years a series of experiments on a laboratory and semi-commercial scale has been carried out at the Forest Products Research Laboratory, Princes Risborough, to explore the possibility of using DDT or other insecticides with a similar type of action for the prevention of infestation by Lyctus. Though the results of this work are not yet complete, they are considered sufficiently promising to justify the use of a spray treatment on a commercial scale, particularly since a practical method of restricting spread of Lyctus on timber-storage premises is most urgent. The spray at present recommended is an emulsion in water containing at least 2 percent DDT. It is made up from commercially miscible oil concentrates in solvent naphtha or xylene containing 20 or 25 percent DDT by dilution with the required amount of water. The spray is a milky fluid which will not discolor or in any way affect the working properties of the timber. Suitable concentrates can be obtained from a number of insecticide manufacturers. The spray is recommended only as a preventive for protecting timber from infestation. It is

not advised for use on timber known to be already attacked or which may have been exposed to infestation by Lyctus, e.g., during the summer of 1947. It is also suitable for the prevention of re-infestation of infested timber which has been sterilized by heat treatment in a kiln.

A new preservative treatment for timber under all conditions of use has recently been developed which impregnates against all forms of rot. It is based on the known bacterial and fungicidal efficiency of phenyl mercury combined with the anchoring properties of Fixtan acid. The substance is odorless and colorless and combines with phenyl mercury to form a powder that is readily soluble in water (1 lb. to 100 gal.) (0.45 kg. to 455 liters), and the preservative for timber thus obtained has, it is claimed, five outstanding properties: (1) deep penetration into timber is obtained by brushing, dipping, and spraying; (2) effective impregnation is fast to washing and weathering; (3) growth of all forms of fungal attack is completely arrested; (4) neither the solution nor the treated timber is dangerous to handle; and (5) timber is entirely uncolored and may be polished or painted without difficulty. As this phenyl mercury Fixtan preservative is described as cheap and easy to handle, and as the transport and storage costs are reduced to a minimum (powder only supplied), wide fields of application to industry are indicated. All construction timbers can be permanently impregnated before or after erection, and mining timbers can be cheaply preserved. The Forest Products Research Laboratory tests on Fixtan acid show that it is highly toxic to wood-rotting fungi, and that it is also resistant to leaching with water.

United States of America

Powell River Company has recently installed machinery with which it is hoped that all waste from groundwood screenings will be eliminated. A Jeffery shredder and Noble Wood refiner have been installed in the company's old groundwood screen room. Exhaustive tests are being conducted with these new machines to determine the maximum efficiency of each unit. The Jeffery shredder consists of several circular knives designed to deal with fairly large wood chips, such as rejects from the knotter screens, which in the past have been a total loss. The wood refiner operates like the grinder, revolving at 1,800 RPM and giving a surface of approximately 12,000 feet per minute (3,700 meters per minute). The rotor has small grooves milled into its surface which act like dippers picking up an equal amount of stock each time they rotate. Grooved shoes are forced to the rotor, just as pulp blocks are forced to the grindstone, through the use of hydraulic cylinders to which the shoes are attached. The machine is equipped with 21 shoes all of which are not always in use, as treatments of various types of stock require different degrees of pressure which is accomplished by releasing or adding shoes.

Because thick beech stock generally splits and checks during air seasoning, beech is often difficult to market or to utilize in the manufacture of wood products. Reducing the seasoning defects would make the use of thick beech stock practical for many purposes. Tests made at a turning mill in Maine show that it is possible to season beech shaving-bowl stock with no greater checking and splitting than birch. The seasoning process tested involved treatment with buffered sodium chloride, a proprietary chemical. The material used in the experiment was approximately 1,600 green beech bars about 2⅛ inches thick (5.40 cm.), 3 to 4⅝ inches wide (7.62 to 11.7 cm.), and 4 to 5½ feet (1.2 to 1.7 meters) long. These were divided into four comparable groups. Each group was given a different treatment and was made into a separate pile for air seasoning. Three of the groups were treated with the chemical, and the fourth was untreated, to serve as a control. Three different ways of applying the chemical were tried: dry spreading, spraying, and dipping. All three groups of beech bars treated with the chemical had fewer seasoning defects than the untreated bars. The results obtained by dry spreading were markedly the best. The values for end checks are less important than those in the other categories because practically all end checks would be removed in the normal trimming operation, in which about 1½ inches (4 cm.) are cut from the end. After air seasoning the stock was kiln dried to a moisture content of 5 percent, in 18 days. An initial kiln condition of 170° F. and 34 percent relative humidity was used, with a final condition of 180° F. and a low relative humidity. The last phase of the experiment was a factory test to determine the number of perfect shaving-soap bowls that could be obtained from the 4⅝ inch (11.7 cm.) bars in each group. The yield from regular birch bars, air-seasoned at about the same time and kiln-dried in the same charge as the beech, was also studied. There were no significant differences between the yields from the regular birch bars and the beech bars treated by dry spreading of the chemical.

The Connecticut Agricultural Experiment Station has developed a satisfactory technique for treating red pine, *Pinus resinosa*, and red maple, *Acer rubrum*, poles to be used for the shade tobacco industry. Several thousand poles have been treated by local operators for use this season, and large orders are coming in for the following year. This has opened a market for thinnings from red pine plantations, as well as for the otherwise unsalable material from red maple swamps. The preservative used is zinc chloride, at the rate of one pound for each cubic foot (1 kg. per 0.06 m^3) of wood treated. For a moderate sized operation, a metal vat 3 ft. wide, 6 ft. long, and 18 in. deep (0.9 m., 1.8 m., 0.5 m.) will permit treating 50 or more poles at one time. The poles must be treated within four days after cutting and the bark should not be removed. They are allowed to stand in the solution, with the butt ends down, 2 to 7 days, depending largely on weather conditions. When the butts are immersed in the solution, the tops are sprinkled with 1 to 2 ounces (28-56 grams) of dry zinc chloride, to ensure a positive treatment of the extreme top end. After removal from the container, the poles are stood vertically, with the butt end up, for 2 to 3 months, to ensure distribution of the zinc chloride throughout the post. Treatment is best accomplished between 1 March and 1 October. In cold weather the intake of solution and its subsequent distribution throughout the post is quite slow.

An experimental installation of glued laminated stringers in a two-span bridge in California is intended to provide information concerning durability and service performance. The stringers were built up from nominal two-inch (5 cm.) stock, each lamina consisting of two pieces edge-glued together. After gluing with a waterproof glue set at 70° F for 24 hours, the stringers were pressure impregnated with creosote by the full cell process, without preliminary incising.

After two years the laminated members are reported in excellent condition.

Wood Utilization

Australia

The Division of Forest Products, Council of Scientific and Industrial Research, Melbourne, reports that, while plywood bonded with a suitable phenol-formaldehyde adhesive can be used for external work in thickness down to ¼ in. (6 mm.), it is advisable to apply paint or other suitable treatment to minimize face checking. Methods of preventing the development of an unsightly network of fine cracks on the surface, one rather unfortunate feature of unprotected plywood used in structures exposed to the weather, are now under investigation at the Melbourne Laboratory. Current research carried out by C.S.I.R. indicates that face checking can be reduced by adjusting such factors in plywood manufacture as the thickness of the veneers and the temperature of pressing. The Australian technologists are also studying the production and characteristics of "flexwood," which consists of a very thin, figured veneer glued to a pliable fabric backing. It is said that a single tree of Queensland walnut of average dimensions could provide enough 1/100 inch (0.3 mm.) veneer to cover a million square feet (93,000 m^2) of "flexwood" paneling.

Australian laboratories have been carrying out a study of the suitability of local species as a substitute for hickory, *Hicoria ovata*, for ski manufacture. Attention was given to density, strength to carry bending loads, hardness, texture toughness (resistance to shock), ease of steam bending, and ease of working with machine and hand tools.

The comparison with hickory was made for five specific factors: density, modulus of rupture (bending strength), modulus of elasticity (stiffness), hardness, and toughness (resistance to shock). For each of these factors, the figures were expressed as percentages of the corresponding values for hickory, placed at 100 percent. The results were published for 16 species, some of which have properties fairly similar to those of hickory, except, perhaps, with regard to toughness. Tests have also been made with laminated skis,

using hard, dense woods, or even a densified veneer, for the running face.

Denmark

Plans have been made for building at Silkeborg, Denmark, a rayon plant with an annual capacity of 5,000 tons rayon, artificial fibers, and cellophane. This is about half the annual requirements. The cost is estimated to be around 30 million kroner, or about 6¼ million dollars.

Finland

The first Finnish factory plant for making sugar out of wood will start to operate in 1948 The production is calculated to be 500 kg. per day in the beginning. The method has been worked out by Dr. Olli Ant-Wuorinen. Experiments have been conducted at Uleåborg for some time and the results have been good. It is possible to get 1 kg. of sugar out of 6 kg. of wood, as well as some by-products which can be used for the production of yeast and alcohol. Sweden is not going to build a similar plant as it has been found there that sugar made of wood is more expensive than beet sugar.

France

Although research is still under way on the planting techniques of homogeneous stands in equatorial regions, work on potential utilization of forest resources in this zone can only be based, in the first stage of exploitation, on utilization of the stands in their present condition On the other hand, inventories and counts taken in various parts of these forests (Ivory Coast and Gaboon) have shown that, because of their markedly omnigenous character, it is extremely difficult, if not impossible, to envisage the manufacture of cellulose on an industrial scale by the processing of a single species, however well chosen. The problem therefore arises as to how to cook heterogeneous mixtures. As the wood of a tropical species is generally homogeneous, it would appear advantageous to use for mixtures woods having different anatomical characteristics. Some preliminary trials were made in the laboratory of the Forestry Branch of the Institute of Tropical Agronomy, at Nogent-sur-Marne, with simple mixtures (4 to 5 species only) arbitrarily determined. The cooking proved to be satisfactory.

Encouraged by these results, the Industrial Administration for Colonial Cellulose, a State agency which now controls the Paper Branch of the above institute, attempted to work out mixtures corresponding to the average of counts taken in seven tracts in the Audouin Forest, in the Ivory Coast. There are 83 different species on these tracts, but in view of the fact that 25 of these species alone represent 85 percent of the exploitable volume, the cooking tests were made only on the 25 species. A proper selection in the various characteristics of the cooking method (quality and amount of chemicals, temperature, etc.) will create good cooking conditions. With the mixture chosen, a total alkali strength varying between 7.5 percent and 20 percent (experimented in caustic soda) resulted in high yields, frequently over 54 percent, in homogeneous pulp. The physical resistance of sheets from such experiments is approximately the same as should be obtained from sea-pine pulp cooked in the same conditions.

Experimentation was carried on with different mixtures from tracts in other forests, but in this case some difficulty arose. For example, for certain woods which were harder to penetrate it was necessary to increase the alkali percentage. This resulted in a lower yield, but did not impair the quality of the paper.

This work has proved the importance of a classification of woods according to cooking properties, and the laboratory has attempted to develop some quick testing methods with a view to (1) determining the absorbent properties of various woods; and (2) classifying woods from the viewpoint of their reactions during standard cooking, such classification being then made according to the ratio between the amount of pulp obtained and the residual uncooked fiber.

Simultaneously, biometric studies are in progress.

At the present time, woods are classified in 7 categories, but it would be desirable to reduce these to 2 or 3, which would eventually permit the division of lumber yards into 2 or 3 groups.

As in the case of individual cooking, the soda-sulphite process gives the best results. This method, as also the sulphate process, is far superior to that which uses only soda. The paper obtained from these pulps can be used either as wrapping paper of the kraft type, or as writing paper or newsprint.

The pulp-bleaching process is not yet defined, for in this case, account has to be taken not only of technical considerations, but also of economic factors, particularly with respect to supply of chemicals.

In the light of the above-mentioned experiments, it can be stated that a great forward step has been taken in the direction of utilization of tropical forests, in their present condition, for the manufacture of paper pulp.

Germany

Two new wallboard plants are being built in Germany, one in Amorbach with a capacity of 20 tons of insulating board per 24-hour shift, the other in the neighborhood of Würtemburg with a capacity of 25 tons of hardboard and 12 tons of insulating boards. Both plants will be equipped with Boija-Jung defibrator machines.

Development of a process for manufacturing high-tenacity rayon from beechwood pulp will save the Combined Zones rubber tire industry approximately one and a half million dollars in imports this year. This rayon, used as fiber in rubber tires, has undergone extensive mechanical and road tests during the past year and has been found superior to conventional cotton thread used at present by German tire manufacturers in the Combined Zones. The pulp is produced by the Waldhof Fabrik at Kostheim, near Weisbaden, and at Mannheim, while the rayon is spun at the Glanzstoff Fabrik in Oberburg. High-alpha-content pulp for bizonal industrial requirements has been imported into Germany at high world market prices, but indigenous production of the beech pulp under the special refining process will cut these imports sharply. Imported pulp costs approximately 250 dollars per ton, while beech pulp can be manufactured in Germany for 950 reichsmarks per ton. Present production capacity in the Combined Zones is about 500 tons of the new pulp monthly, slightly less than requirements for the 1948 tire production goal, which is 120,000 tires monthly by mid-summer. Experiments toward producing high tenacity rayon from beech wood were started over a year ago by German firms, with the help of United States technicians, in an effort to find a good indigenous substitute for cotton thread used in rubber tires. The final product was turned over to Combined Zones tire firms in February 1947, for testing. Prewar and wartime experiments were carried on in Germany in order to develop this process but they were never successful, and the idea was abandoned. The United States has produced a similar high-tenacity rayon from certain species of spruce and pine for the last ten years, but Germany lacked sufficient quantities of these species and had to rely on beech wood. However, Germany had gone far in producing a staple fiber from beech, which was used in cloth as a substitute for cotton and wool. The difference in manufacture between the staple fiber and the long continuous high-tenacity thread consists in the washing out of impurities from the latter during the pulp-making process. Coal required for such production is not excessive, and valuable by-products, such as yeast and alcohol, are obtained from the pulp.

Due to the increasing scarcity of wood resulting from exhaustive cutting during the war, as well as the great demand for building timber, mine wood, and export needs, the pulp and paper industry in Germany is forced to find new raw materials to replace wood. In addition to the species of wood, such as spruce, fir, and pine that have been commonly used for the manufacturing of pulp, it is well known that for many years great quantities of beech wood have been used for manufacturing artificial silk and rayon But even poplar, aspen, and birch wood have been used for that purpose. Among the crops which are annually harvested from fast-growing plants in Germany, only corn straw, herbaceous stalks of potatoes, and reed can be taken into consideration. The annual production of wheat and rye straw is estimated at about 25 million tons, while production of oat straw, rape, and other kinds of straw amounts to about 15 million tons. On an output basis of 33 percent, a fiber yield of about 13 million tons ought to result from the above quantities of straw. Unfortunately, this straw yield cannot be supplied to the paper industry because it is needed for agricultural purposes such as food and chaff. During the last war, the processing of the annual crop of millions of tons of potato-plant stalks was considered with a great deal of optimism, and a special method of manufacturing was de-

veloped. Indeed, a few thousand tons of potato stalks were gathered and made into pulp, which was suitable for manufacturing rayon. Since the end of the war this method has been practically abandoned. The difficulties encountered in gathering the stalks, their transport to the pulp mill, the storing of the material during the time between the crops, and last but not least, the very low yield of pulp make this process unprofitable from an economic point of view.

Reed of no present commercial value has been suggested as a third source of raw material for papermaking. In Germany there are three particular species of reed, namely, the broad-leaved stalk, *Thypha latifolia*, the slender-leaved stalk, *Thypha augustifolia*, and the little reed stalk, *Thypha minimar*. In Germany the annual harvest of reed is estimated to be about 1 million tons, with deduction of 27 percent for leaves and 14 to 15 percent for leaf stems; the yield of the rest is scarcely 30 percent. Therefore, the processing of reed into pulp has been unsuccessful up to now. The reaping, drying, and conveyance of the reed to the pulp mill is also troublesome and expensive. Better results have been obtained in Italy with *Arundo donax*, a kind of reed growing in warmer regions which produces bamboo-like stalks up to a height of several meters. An engineer at Freiberg, Saxony, recommends the cultivation of sunflowers, *Helianthus annuus*, whose stalk contains fibrous material of a high quality. The prospect of obtaining not only valuable sunflower oil but also raw material for the pulp and paper industry is quite attractive. The sunflower, however, grows only on good soil, demands much sunshine, and withdraws from the soil precious nutritive material which must be replaced by means of increased manuring. Similar problems are met in cultivating rape, a plant which yields both oil and straw. The latest suggestion for getting raw material for the German pulp and paper industry concerns German broom, *Sarothamnus scoparius*, a wild shrub with rod-like twigs, little frail leaves, and golden blossoms that strike the eye in springtime. This plant likes a sandy soil with a very small percentage of calcium; its growth is unfavorably influenced by good vegetable soil and permanently wet ground, as well as by a too dry climate. However, a useful processing of lignified stalks of broom is now possible after extensive research in laboratories and mills, and many tons of various kinds of paper of a remarkable quality have been produced. Broom is sown in the spring when night frosts are no longer expected. One-half kg. of seed is needed for one hectare. Because of the resistance of the hard seed shell to penetration of water, the seed is prepared by means of scratching machines. After three years of ripening the crop is brought in by means of a specially constructed mowing machine in a manner similar to the harvesting of corn. The annual crop is considered to amount to ⅝ ton of broom from every hectare under favorable growing conditions. This will yield about 1.7 to 2.7 tons of pulp. Nothing has been stated hitherto with regard to the pending patent proceedings concerning the method of disintegration, except that neither of the usual acid or alkaline methods will be employed.

Spain

Among novel developments in Spain, according to Dr. Aries, Director of the Northeastern Wood Utilization Council, Brooklyn, U.S.A., are two plants making rayon from straw, a development which has taken place in the U.S.A. only on an experimental level. "In addition," he says, "there is a wallboard plant under construction which will use sawdust. The future plans in Spain include a mill to pulp esparto and a number of new paper mills."

Sweden

A Swedish paper company is making parachutes out of paper These will be used by the Peary land expedition to Greenland for the delivery of sundry stores to the exploring parties. They will also be used for various purposes in the French colonies. The Swedish company began making these paper parachutes during the war, and is the sole maker of this type. This parachute has a carrying capacity of 100 kg., and it is resistant to salt water, which the usual nylon parachutes are not.

United Kingdom

A new sheet material, Rubberwood Board, is now manufactured in Great Britain. The manufacturers point out that the board has the specific gravity of medium density hardwood and that it is made from chemically treated sawdust bonded by heat and pressure with a minimum amount of synthetic resin. They claim that the process through which the material passes imparts a considerable degree of self-bonding properties to the sawdust, so that less resin is required to give mechanical strength than is common in similar types of board. This property ensures that the material can be worked by ordinary woodworking tools without undue wear or necessity for frequent sharpening. Applications suggested for Rubberwood include furniture, paneling, flooring tiles, partitions, and cores for veneered boards.

It has been announced recently that revolutionary new processes in the manufacture of pulp-molded containers will be put into operation in the near future. They have been the subject of considerable research and the manufacturers claim that their improved methods increase the present rate of production in such proportions that, for the electric light industry alone, they will be able to supply sufficient containers to package every electric light bulb of any description that is produced in the British Isles. The container is made to the shape of its contents and is comprised of two parts completely enclosing the bulb but leaving the metal holder protruding so that it can readily be pushed into the testing socket at the time of sale. The two parts join round the middle and hold together by means of the flanged edges which overlap and are slightly tapered so that the curve of the bulb's surface pushes them securely together. Many advantages are offered by a pulp-molded container: it has shock-absorbing qualities, its light weight reduces transport costs, and its molded shape saves space in bulk packaging.

Imperial Chemicals Industry is to open a new large-scale factory in Scotland for the manufacture of the cellofas products for which a very great demand has developed in the last years. Nitro-cellulose research has been dealing recently with a number of cellulose derivatives, chief of which was a group of the ethers of cellulose which are called by the trade name of "cellofas." This group of substitutes has many applications: as an emulsifier and thickener in foodstuffs; for finishing cloth in the textile industry; as a binder in pulp and papermaking; and lastly, a new development, as an emulsifier for mud in oil-well drilling. Although the new plant will take up production on a large scale it may not be large enough according to the latest estimates to fulfill all requirements and may have to be expanded.

In view of the approach of the Olympic Games there is considerable topical interest in an announcement regarding the design of a new British-made kayak, a number of which will be used in the regatta section of the Olympic Games. The new kayak is unique in that, as opposed to light wood ribs over which is stretched doped fabric, it is a ribless monocoque shell formed from molded veneers laid up in three-ply construction and bonded together with a synthetic resin adhesive. Nails, rivets, and wires are entirely absent, with the result that the hull takes on a perfect streamlined shape and is enormously strong and rigid, by virtue of the method of forming the shell by correct disposition of veneers bonded together with a synthetic resin adhesive.

United States of America

A new shipping case sealing adhesive, Boxseal Glue, designed especially for automatic case-sealing machines, is now in production. The manufacturers claim that it will successfully and speedily seal the flaps of Fourdrinier Kraft, cylinder Kraft, and jute-lined corrugated containers, as well as the solid fiber types. Although emphasis is placed upon Boxseal as an automatic machine sealing adhesive, it can also be applied by hand brushing. As such, it serves to hold shipping labels, express waybills, etc., to shipping boxes, as well as for use as a flap-sealing glue. The glue is descried as a liquid-converted starch-derived adhesive. The method of manufacture increases immensely the adhesive power obtainable from the raw materials. It enables the glue to coat a thinner, more cohesive film on the container board without excessive penetration into the board fibers. The glue remains on the surface to make positive contact with the container flaps when they are pressed together. The makers point out that unlike ordinary starch-derived adhesives, it remains in a fluid condition indefinitely, permitting it to be piped directly to the machine glue pans without danger that the adhesive will solidify in the pipes and cause stoppages. Dilution of the glue is dependent on the porosity of the container board in use, ranging from 15

to 50 percent by volume and on a setting speed range of 20 seconds to 60 seconds. At 25 percent dilution tests show 85-percent fiber tear on containers in 35 seconds.

The University of Wisconsin reports that three of its biochemists have discovered a method of using sulphite waste in the manufacture of lactic acid, a product used in the tanning, lacquer, and food-processing industries. The scientists are Reid H. Leonard, W. H. Peterson, and M. J. Johnson. Their work was financed partly by a grant from the Rhinelander Paper Company, Rhinelander, Wisconsin. Under their process, excess sulphur is removed from paper mill waste by treating it with steam Malt sprouts, blackstrap molasses, and lactic acid can be recovered from fermented material by using solvents. One advantage of the new process is that 95 percent of fermentable sugars in the waste are recovered in lactic acid. Other fermentation methods recover only about 50 percent of the sugars for salable products.

Mr. Lawrence Ottinger, president of the United States Plywood Co., speaking recently on the occasion of the opening of a new warehouse in Tampa, Florida, jointly owned by the Mengel Co. and U. S. Plywood, announced that his company would import about 6,500,000 square ft. (600,000 m^2) of Korina plywood a month from the Belgian Congo. In making the announcement it was revealed that all warehouses of the U. S. Plywood Co. and U. S. Mengel Plywoods, Inc., had been supplied with the new Korina plywood, a light-colored hardwood which was being welcomed by architects, decorators, and furniture manufacturers, who regarded it as a good substitute for the more expensive and scarce prima vera, or white mahogany. When the company's import program was fully underway it was expected that 4,500,000 square ft. (410,000 m^2) of the imported timber would be used for fine veneers, while 2,000,000 square ft. (190,000 m^2) of lower grade stock would be used for less expensive plywood. The price of the imported product, said Mr. Ottinger, was approximately one half that of prima vera. In addition to fulfilling U. S. Plywood's need for raw material, and providing needed dollars for the Belgian Government, which owns the forest lands, the new discovery will lead to the establishment of another industry along the sparsely settled Gold Coast. At Port Gentil, French Equatorial Africa, the American company will build the largest hardwood plywood plant in the world, for French interests. The company's engineers will set up the plant, and when it is in production it will be turned over to the French. The plant's capacity will be in excess of 10,000,000 square ft. (930,000 m^2) a month, and the raw material for the mill will be okoumé, a fast-growing tree which is available in large quantities and sufficiently close to tidewater for economical production.

Yugoslavia

In order to meet the demand for wallboard in Yugoslavia new plants will have to be built. The first one is to be delivered complete from Sweden and erected in Bosnia and Herzegovina and will have a capacity of 6,000 tons of hardboard and 6,000 tons of insulating oard per annum. Later, it is intended to expand the production of insulating boards to 12,000 tons per annum. The plant will be equipped with Boija-Jung defibrator machines. New plants will probably be built in Croatia and Serbia also.

Economics and Statistics

Argentina

According to preliminary data, newsprint imports into Argentina during 1947 approximated 153,000 metric tons, of which nearly 7,000 tons were imported by the Argentine Government. The largest supplier was Canada (38,000 tons); other important sources were Sweden (35,000 tons), Finland (28,000 tons), Newfoundland (28,000 tons), and Norway (23,000 tons). The United States of America supplied about 60 tons valued at 4,894 dollars according to United States preliminary export statistics. Total newsprint imports into Argentina in 1946 amounted to 142,600 tons. Efforts are being made to increase domestic paper production. New machinery has been ordered and is expected to be delivered in 1948.

Australia

There are now 1,688 factories in Australia engaged in manufacturing paper and paper products. These include 82 manufacturers of stationery and paper products; 86 manufacturers of cardboard boxes, cartons, corrugated boxes, etc.; 37 manufacturers of paper bags; and 12 manufacturers of paper. In the latter category, Victoria has five factories; New South Wales, two; Queensland, one; South Australia, one; and Western Australia, one. The total number of persons engaged in the manufacture of paper is 4,625 (3,956 males and 669 females), and salaries and wages for the year amounted to £1,525,871 (£1,402,728 for males and £123,143 for females). Total value of materials used throughout the whole of the industry during the year was £19,140,302 (approximately $91,873,450 at par).

Canada

A record pulpwood cut in 1947/1948 may go as high as 10 million cords (25 million m^3 (r)), thus allowing many Canadian pulp companies to bring their pulpwood inventories back to normal for the first time since before the war. The chief reasons for this record cut are almost ideal weather conditions and a labor force which reached a peak of 80,000 men in the latter part of November. Altogether 192,000 men were engaged in pulpwood operations in 1947/1948.

Czechoslovakia

Exports of chemical and other wood pulp from Czechoslovakia totaled 41,810 metric tons and were valued at 359,880,000 crowns (1 crown = U.S. $0.0201) during the first 9 months of 1947 (latest data available). Exports of paper and paperboard amounted to 32,673 tons and were valued at 497,094,000 crowns. Exports of paper and paperboard products amounted to 3,297 tons and were valued at 151,559,000 crowns. The total value of exports of paper and related products (1,008,533,000 crowns represented 3.5 percent of the value of all exports during the period under review. Imports of paper items were as follows: chemical pulp, 1,957 tons; paper and paperboard, 2,817 tons; and paper products, 68 tons.

Finland

Since 1945 Finland has exported 35,000 wooden houses to Soviet Russia. This number includes 12,000 houses which had to be delivered in connection with the peace treaty. Poland is the second largest purchaser of wooden houses. Last year this country imported 2,400, while this year the figure will be 1,700. Finland also exports to Great Britain, Denmark, and other countries.

Timber production in the 1947 season was 43 million m^3 (r) — some 10 million less than in the two previous seasons. The severe winter and the drought hampered the timber-floating program. Industry in general suffered from a shortage of hydroelectricity, but production was maintained at about the 1935 level and appreciably above that of 1946. The index of production (1935 = 100) for the year averaged 102 for home industries, 78 for export industries, and 105 for all industry compared with 102, 64, and 86 respectively in 1946.

At the opening meeting of the twentieth Finnish Forest Week in Helsingfors on 3 April, the Secretary of State gave some particulars of this season's lumbering results According to reports received, only about 75 percent of the felling program can be effectuated as far as merchantable timber is concerned, while the result will probably be even worse as regards fuel. Out of an estimated 45 million m^3 (r) to be felled this season, only about 34 million m^3 (r) will be cut. Out of the 17 million m^3 provided by the fuel program, the particulars received indicate that the final result will be somewhere about 10 million m^3 (r). The Secretary of State thought it most important that the lumbering work should be made more effective.

The total production of the board industry during 1947 was 135,000 metric tons, a 7 percent increase over 1946 production of 126,000 tons. This represents about 93 percent of capacity and is very satisfactory considering the difficulties encountered, in particular the lack of water power during the latter part of the year. Production will be considerably lower on account of these difficulties during the winter months of this year. Finland exports to 45 different countries, the chief of

which are listed below in order of their importance:

Exports to:	*Metric tons* (Approximate)
United Kingdom	21,000
U.S.S.R *	15,000
Denmark	14,000
Argentina	8,500
U.S.A.	7,000
Belgium	5,000
Egypt	4,000
France	4,000
Holland	3,000
New Zealand	3,000
Ireland	2,500
Palestine	1,000
Other countries	6,500

*The figure for U.S.S.R. includes the reparation deliveries.

Although the demand in different markets for board has been lively during 1947, international trade has been faced with many difficulties, such as the ever-increasing government regulations, import restrictions, and currency regulations. These difficulties have hampered sales to a great extent, and the exceptionally large stock of orders has decreased considerably so that the mills can now make quicker delivery. The price situation is still very firm and there have been substantial increases in the cost of production in Finland as well as in the Scandinavian countries. It is expected that, although government regulations abroad might slow up Finnish exports of board, demand in the different buying markets will result in a fairly lively trade during 1948.

The wallboard industry of Finland at present comprises seven mills with a total annual capacity of about 75,000 tons. An eighth factory is now under construction. When it is completed, and the other mills receive additional machinery necessary for making hard board, the total capacity of the industry will reach 140,000 tons per year, of which about half is soft board and half hard board.

French Equatorial Africa

In French Equatorial Africa the output of timber has increased. It was nearly 100 percent higher in 1946, with 100,000 metric tons of wood, as against 56,000 in 1945. Okoumé logs account for 90 percent of these totals. Further progress, however, will have to surmount serious difficulties.

Substantial advances were made in 1946/47 in the development of French colonial forestry production. In the case of French Cameroun, export figures were even higher than the peak exports for 1939.

It should be pointed out, however, that this situation may not continue, since shipping costs alone are as high as the cost of European woods. In fact, the vast markets for tropical woods are shrinking in proportion to the increase in production costs. It may be noted that transport rates for natural woods represent an increase of 1,850 percent as compared with prewar rates, while f.o.b. prices for wood, after the devaluation of the CFA franc (African franc), are only about 8 or 9 times those of 1938/1939.

Germany

Paper is very short in Germany. The British Zone is particularly badly off, as it contains none of the larger pulp-making centers. Throughout Germany less than 40 percent of the pulp and paper mills have managed to resume operations. War damage and dismantling have made substantial inroads into productive capacity, and the per caput consumption of paper by the German population is drastically reduced in comparison with the prewar figure. Nevertheless, the importance of paper — especially newsprint, with its intimate relation to propaganda—is appreciated by all the occupying powers. In the Russian Zone newsprint enjoys high priority, and, as better supplies of pulpwood are available, newspapers are larger there than in the British and American Zones.

There is considerable trade in paper between the Eastern and Western Zones The barter of newsprint, printing and writing papers, etc., for engineering equipment, chemicals, and other materials which are scarce in the Eastern Zone is sanctioned. This barter has already involved thousands of tons of paper.

War struck heavy blows at the German paper industry, but it has not quelled the urge for research work. A lot of this is going on, directed to the use of fast-growing poplars and certain other plants as raw materials. One mill in the American Zone has established a pilot plant, where experimental work is now proceeding. The production of artificial resin is another field in which research is being actively pursued. Demand for paper mill machinery and equipment is far in excess of supply and the output of the German manufacturer is booked up for years ahead.

Honduras

In Honduras wood felling is very important, both for the home market and for export. The bulk of the exported wood consists of mahogany, pine, and cedar, while other kinds of wood are exported only to a very insignificant extent. During 1945/46 the following quantities were exported:

Mahogany	4,236 m^3
Pine	5,587 m^3
Cedar	863 m^3
Cross beams	138,000 kg.
Miscellaneous	529 m^3

Besides the above-mentioned types of wood, Honduras produces oak, nutwood, ebony, and numerous other woods amongst which are many valuable species.

The country possesses an extensive wood reserve. A tax is levied for wood felling on State-owned land and it varies with the quality of the wood, i.e., from 24 lempiras per tree for mahogany to 2 lempiras per tree for pinewood. For the current year the taxes thus levied are estimated to average 50,000 lempiras. The cost of timber is largely dependent on transport expenses. The forests consist of mixed woods. This offers difficulties in felling special quantities of the same kind of wood and also in arranging transport facilities.

India

Plans have been made by a private company in India to establish a plant for the manufacture of newsprint, at Chandni, between Khandwa and Burhanpur, in the Central Provinces, and near a branch of the Bombay-Delhi Railway. The factory will be situated in a 375,000 acre (152,000 ha.) forest. The broadleaved trees will be the raw material used for the production of newsprint which is expected to be at the rate of 100 tons daily within two years. At present, India is entirely dependent upon imports, for its newsprint requirements. Although imports generally have been about 40,000 tons annually, estimates are that approximately 90,000 tons would be used if supplies were available. When the national education program gets under way, the demand is expected to increase 400 percent.

The industrial Panel on Paper and Board Industries in India has published a report regarding the future of the Indian paper industry. The following estimates have been made:

	1951 (*Long tons*)	1956 (*Long tons*)
Paper consumption	280,000	412,000
Paper production	189,000	342,000
Paperboard production	75,000	119,000

As the Panel suggests that India ought to be self-supporting in regard to newsprint, it is proposed that the Department of Agriculture immediately make an inventory of all raw materials suitable for production of paper, including different species of wood, bamboo, straw, rags, etc. It is suggested that the present government aid to the paper industry be continued and even increased. The possibilities of making machines for the paper industry within the country will be examined.

It is also recommended that the Forest Research Station at Dehra Dun be reorganized so that it can serve as a center for pulp and paper research. The possible use of bamboo pulp in the artificial silk industry is suggested as a subject

Production of Timber in French Equatorial Africa

Gaboon	*Unit*	*1946*	*1947*
Okoumé roundwood	m.t.	80,072	109,042
Various roundwood	m^3	5,972	13,889
Sawn timber and veneer	m^3	13,653	10,469
Middle Congo			
Okoumé roundwood	m.t.	109	2,898
Various roundwood	m^3	3,935	2,279
Sawn timber and veneer	m^3	4,715	3,910
Cameroun			
Roundwood	m.t.	22,192	36,915
Sawn timber	m.t.	13,017	17,338

for investigation.

A further recommendation is made to the effect that six students per year be sent abroad to study the pulp and paper industry.

Italy

Italian production of all types of paper and cardboard is estimated at 375,000 metric tons for 1947. This compares with 175,000 tons in 1946, a maximum of 538,000 tons in 1940 and an average of 492,000 tons for the five-year period 1935-39. Shortage of coal and imported wood pulp, as well as some war damage to plant, resulted in heavy curtailment of production in the period 1943-45. The chief bottlenecks at the present time are coal and chemical pulp. Before the war the industry used about 200,000 tons of coal, but since coal imports are now only about 60 percent of normal, this will have some effect on the industry, despite more extensive use of electric power. However, the most serious shortage is of chemical pulp. The following figures show the extent to which Italy depends on imported supplies:

Italian Imports and Production of Chemical Pulp

	Imports (*Metric tons*)	Production (*Metric tons*)
1935	241,000	12,000
1936	110,000	24,000
1937	125,000	37,000
1938	120,000	38,000
1939	130,000	62,000
1940	111,000	75,000
1941	100,000	90,000
1942	140,000	64,000
1946	116,000	30,000
1947	132,000	n.a.

Supplies of mechanical pulp are mostly produced in Italy, to a large extent from poplar wood. Prewar production averaged 140,000 metric tons a year. Average imports were about 6,000 tons, mostly from adjoining countries, of which Austria was the principal one.

It is difficult, however, to arrive at an exact estimate of production and consumption of newsprint paper. There are no official figures of production though prewar productive capacity was probably fairly close to 85,000 metric tons per annum. It is doubtful whether domestic consumption was ever much higher than 65,000 tons, so a surplus was available for exports. Production declined greatly during the war years, but the productive capacity was not greatly damaged, with the result that demand, now estimated at about 60,000 tons per annum, could readily be filled from domestic sources were the necessary raw materials available.

When considering Italian imports of pulp, it seems reasonable to include imports of cellulose for the artificial silk industry. In 1938 the Italian rayon and staple fiber industry was the third largest in the world, producing a total of 124 million kilograms of fiber, and requiring 186,000 metric tons of cellulose. Of this requirement, 70,000 tons were produced in Italy, import requirements being, therefore, about 116,000 tons. The industry reached its high production point in 1941, with 197 million kilograms of fiber. By 1945, production was totally arrested, and estimated production in 1946 was 40 million kilograms, or one fifth of capacity. During 1946, however, by compensation agreements with Sweden, Austria, and Norway, Italy was able to obtain fairly large supplies of rayon cellulose, most of which arrived toward the end of the year. Total imports were 68,250 tons while imports in the first eleven months of 1947 were 80,000 tons. It is possible, therefore, that 1947 production of fiber reached the planned figure of 120,000 tons, or about 60 percent of current capacity.

Japan

According to reports, SCAP intends to push ahead its plans to re-establish the Japanese rayon-producing industry as an important factor in the world rayon market. The current revitalization program calls for the accomplishment of the following objectives: (1) rehabilitation of the rayon-producing industry to a total capacity (yarn and staple) of 330 million pounds (150 million kg.), from which an annual average output of 308 million pounds (140 million kg.) can be obtained; (2) eventual attainment of an annual domestic per caput consumption goal of 1.4 pounds (0.64 kg.) of rayon filament yarn and 1.3 pounds (0.59 kg.) of staple; (3) establishment of annual consumption of 1.75 million pounds (0.79 million kg.) of rayon staple for industrial uses; and (4) increasing the annual export level of filament yarn products to 60 million pounds (27 million kg.) and rayon staple products to 30 million pounds (14 million kg.).

The rebuilding of Japan's rayon output to an annual level of 308 million pounds (140 million kg.) a year means that the industry will eventually be restored to the extent of 57 percent of the peak 1938 output level of 541 million pounds (245 million kg.). Most of the rehabilitation will be concentrated in the filament yarn section.

If judged by the progress made during 1947, the completion of this rehabilitation program will take a number of years. Production goals for 1947 were set at 30 million pounds (14 million kg.) of rayon filament yarn and 24 million pounds (11 million kg.) of staple for a total of 54 million pounds (24 million kg.) However, it is estimated that actual 1947 output amounted to 16 million pounds (7 million kg.) of filament yarn and 19 million pounds (9 million kg.) of staple for a total of 35 million pounds (16 million kg.). Filament yarn production, therefore, reached only 54 percent of the target, while staple did better at 79 percent of its goal. The failure to meet these targets was due primarily to insufficient coal supplies and shortages of wood pulp, caustic soda, and other basic chemicals. In addition, an extensive reconditioning of producing equipment is necessary.

The future export goal of 90 million pounds (41 million kg.) of yarn and staple represents about one-third of the planned annual output. The purpose of this sizable export volume is to obtain foreign exchange for the purchase of raw materials and foodstuffs. The countries with whom this export trade will be carried on have not been mentioned. The principal prewar markets for Japanese yarn and staple included India, China, Netherlands Indies, Australia, and the Japanese empire areas; the United States also imported substantial quantities of staple before the war. It may be of interest to note that India currently is building its own rayon producing industry, and plans are being considered for the establishment of rayon-producing units in Australia and China.

Philippines

Negotiations are under way between the Philippine Government and a firm in the United States for the purchase of a paper mill to be installed in Manila this year. The mill, it is understood, has a production capacity of 30 tons per day. It is capable of making newsprint as well as higher grades of paper.

Additional pulp mills are to be established in various parts of the Philippines in the near future, it is learned. These mills will be put in areas where raw material, such as cogon, corn and rice husks, and abaca, are abundant.

Poland

The total production of paper in Poland in 1948 is likely to exceed 253,000 metric tons, as compared with 205,000 last year. The annual newsprint consumption has risen from 2.2 lbs. (1 kg.) a head in 1937 to 3.3 lbs. (1.5 kg.) in 1947.

Raw material supplies in 1948 are expected to be larger than in the preceding year due to a more even production rate in the various subsidiary factories.

The shortage of waste paper is serious and this necessitates its importation in large quantities from abroad. Recently, an intensive publicity drive has resulted in an increase in the monthly rate of waste paper deliveries from 1,500 tons to 3,000 tons.

Large sums are to be devoted to the repair of run-down machinery and to maintaining regular supplies of power. Rehabilitation of war-damaged factories will be continued, particularly in case of plants producing pulp and cardboard. Also, reconstruction of a viscose pulp factory is contemplated during 1948.

The number of employees of the Polish paper industry will this year exceed 29,000. This figure includes all sections such as sales and distribution.

Portugal

Consumption of wood pulp by the paper industry in Portugal in recent years has averaged nearly 18,000 metric tons annually, about one third of which is produced by the country's only pulp mill.

Sweden was the only supplier of imported pulp in 1944 and 1945, and the principal source in 1942 and 1943. In the two latter years, small quantities were imported from the United States and Canada.

The paper produced by the 75 manufacturers is limited to a very few types, all of which are low-grade and, in general, inferior quality. The newsprint and printing stock made are acceptable to the trade, but output is kept at a minimum since it is more profitable to manufacture products which are protected by tariffs. No attempt is made to produce papers involving special or complicated processes. Paperboard is

made, but it is not adaptable to many uses.

Paper consumption in Portugal has increased during the past 10 years. The annual average per caput consumption for the period 1942-45 was 12.3 pounds (5.6 kg.), compared with 11.5 pounds (5.2 kg.) in 1937.

Sweden

Forest products are still by far the most important exports from Sweden. Forest products accounted for 53 percent of the total exports from Sweden in 1947 as against 38 percent in 1939; mineral products showed a decline to 6 percent in 1947 from 19 percent in 1939.

Paper production in Sweden amounted to 1,040,000 metric tons during 1947, compared with approximately 1,012,000 tons in 1946 and 978,000 tons in 1937. Most paper mills worked at capacity until operations were hampered by the rationing of electric power in the fall of 1947. Domestic consumption was reduced to 465,000 tons in 1947 from 530,000 tons in 1946, as a result of legislation brought about by a new Swedish foreign-exchange policy. Despite the fact that paper production has increased steadily during the past 10 years, with the exception of the war years, exports have declined. Domestic consumption, however, has nearly doubled in the past 10 years. The Swedish Government reduced 1947 consumption by tightening domestic quotas, and new allotments which became effective on 1 January 1948 will further reduce home consumption to 411,300 tons in 1948, if the present rate of allotment is continued throughout this year. Based on production and consumption data, paper exports were not more than 575,000 tons in 1947. In 1937, paper exports were 664,000 tons. Exports of wood pulp from Sweden totaled approximately 1,735,000 metric tons during 1947, compared with 2,200,000 tons in 1937. Chemical pulp accounted for 1,510,000 tons of the 1947 pulp exports, and the remainder was mechanical pulp.

The Government Fuel Commission in Sweden has officially announced that for the present season half a million standards of sawn and planed goods will be reserved for export. Quotas have been fixed for all the principal exporting countries, totaling at present 421,850 standards (1,970,883 m^3 (s)). Great Britain is first on the list with 162,000 standards (757,000 m^3 (s)). Next comes Belgium-Luxemburg with 80,000 (370,000 m^3 (s)), followed by the Netherlands with 69,000 (320,000 m^3 (s)), Denmark with 45,000 (210,000 m^3 (s)), and South Africa 20,000 (93,000 m^3 (s)). These are the chief importers, and smaller quantities have been allotted to Australia, Egypt, Ireland, Palestine, other countries within the sterling area, and Norway, France, North Africa, and Italy. In addition to these quantities of sawn and planed goods, 40,000 actual standards (190,000 m^3 (s)) will be allotted for export in boxboards and squared timbers.

Switzerland

The principal prewar sources of paper and paperboard supplies for Switzerland were Sweden, Finland, and Austria. Swiss wood pulp imports have generally run to approximately 10 percent of domestic consumption, or about 20,000 tons. The domestic industry has been unable to meet requirements since post World War I years, and this is still the case. In the period between the two wars, the proportion of domestic pulp used was greatly increased, and during the recent war Switzerland was compelled to rely almost exclusively on its home supply. However, in 1946, pulpwood output in the country was only about 120,000 tons, and even with imports, the total available to pulp mills was below requirements. Supplies to the mills in 1948, as in 1947, will depend on imports and the number of workers in the domestic timber industry. Imports of chemical pulp in 1946 ran to 66,000 tons The 1947 paper production is estimated by the industry as about 150,000 metric tons, compared with 115,000 in prewar years. Paperboard production is estimated at 45,000 compared with 30,000 to 35,000 tons prewar. Newsprint is expected to show only about 25 percent of production for 1947. Swiss demand for paper is estimated at 150,000 tons annually and paperboard 55,000 tons. Domestic production supplies about 90 percent of paper and paperboard requirements, the remainder being made up of imports.

Ukraine

In 1937 the Ukraine produced 28,400 tons of paper, as compared with 22,600 tons in 1932. This output represented, in 1937, 3.42 percent, and, in 1932, 4.8 percent of the Soviet Union's total paper production. In 1946 the reviving paper industry of the Ukraine turned out about 9,500 tons of paper and cardboard, exceeding its production program by 10 percent. This year the output of paper and cardboard is expected to be more than double that of 1946.

The first section of a mill producing paper bags has been launched in the Dragobych Region, and another paper mill is being built in the same region. Two cardboard factories are being built, one in Lvov and one in Rakhov (Transcarpathian Region).

United Kingdom

Under the Marshall Plan, Britain has been tentatively allocated £331,075,000 during the first year, according to a United States Government announcement. Included in the allocation is timber valued at £15,825,000, and timber equipment with a value of £425,000. The figure for timber shows a small reduction on the State Department's estimate announced in January last. At that time it was tentatively stated that the allocation for Great Britain would be £3,575,000 from April to June, 1948, and £14,250,000 from July 1948 to June 1949. During 4½ years' operation of the Marshall Plan this earlier estimate allotted Great Britain a total of £61,250,000 for wood.

The prewar consumption of wallboard in England is figured to be 14.6 million m^2 of which 8 million m^2 were covered by domestic production. A consumption of 15 million m^2 is anticipated for 1948 of which 7 million m^2 can be covered by domestic production. The figures for the next three years are estimated to be 17 and 9 million m^2 respectively.

The total of materials received during 1947 by the paper industry of Great Britain was 1,064,808 long tons against 950,141 tons in the previous year and nearly 2 million tons in 1938. Although wood pulp imports were lower in 1947 than in 1946, this loss was more than compensated by the receipts of esparto grass, although the grass does not offer such a high yield of fiber. Consumption of materials, comparing 1947 with 1946, showed a decline in pulpwood of approximately 23,000 tons, in wood pulp of 72,000 tons, and in straw of 106,000 tons. Consumption of esparto grass, rag, and waste paper was higher. Total production of all papers and boards during 1947 was 1,735,940 tons, actually 40 tons higher than the previous year. This was a very creditable performance in view of the coal crisis in 1947.

United States of America

One aspect of the wood pulp field which has been growing tremendously, is the manufacture of rayon. The rayon industry continued to grow even throughout the depression. In 1945, pulp consumption for rayon manufacture amounted to 400,000 tons, of which nearly 300,000 tons was wood pulp, the remainder being cotton linters. The decrease, percentagewise, of wood pulp in rayon manufacture since 1942, again reflects the shortage of wood pulp in the country during this period. The possibilities for future growth of rayon-grade wood pulp consumption are almost fantastic. The American Viscose Company, which produces large quantities of rayon for automobile tires, anticipates the manufacture of enough rayon cord for approximately 50 million passenger car tires in 1947. This amount is only about two thirds of the annual passenger car tire requirements of this country. The consumption of rayon cord for 1946 has been projected to give a figure for the year of 205 million pounds (93 million kg.), which is over 50 percent greater than the consumption in 1945. This amount is still only about one half the present rate of consumption of all types of tire cord, and is only one illustration of the numerous potentialities for wood pulp consumption in this field.

U.S.S.R.

The fourth Five-Year Plan of the U.S.S.R., which was adopted on 16 May 1946, has as its principal goals not only rehabilitation of the regions devastated by the war and restoration of agriculture and industry but also progressive industrialization at the rate provided in the preceding plans.

The two major objectives are therefore still the same, namely: (1) development of nationalized industries, and (2) organization of agriculture on the basis of large, mechanized, collective farms.

The State Planning Commission of the U.S.S.R. has just drawn up a report on the development of the major industrial commodities during the postwar period.

As regards wood and its by-products, production figures are as follows:

Product	1946	1947
	(Index 1945 = 100)	
Timber	106	134
Paper	161	201

The percentages of actual production of forest products relative to planned production are as follows:

Product	1946	1947
	(Percentage)	
Timber	98	96
Pulp and paper	110	98

The prewar production of the U.S.S.R. and the targets for 1950 are:

Product	1936	1950
	(Million m³)	
Timber	176	280
Sawmill products	34.2	39

Policy, Legislation, and Administration

Andaman Islands

Details of a Government-controlled corporation to exploit the timber resources of the Andaman Islands were given in the Indian Legislative Assembly at New Delhi by Mr. Jairamdas Daulatram, Minister for Food.

Mr. Daulatram said that Anamalais Timber Trust, Ltd., Hind Constructions, Ltd., Dalma Jain, Ltd., and Himabslingha Timber, Ltd.—the four promoting firms—and the Government, with shareholders from the public, would form a corporation named the Andamans Forest Industries, Ltd.

Out of the authorized capital, 51 percent of the shares would be held by the Government of India, 40 percent by the firms, and 9 percent would go to the public. Among the terms and conditions of the lease of the North Andamans forests were that the chairman of the board of directors would be one of the two Government directors, and he would be nominated by the Government.

The corporation will abide by the directions issued by the Government from time to time regarding the prices at which varieties of timber could be sold at the various markets.

The corporation would work the forests only according to instructions issued by the chief forest officer.

Argentina

The Technical Institute in Buenos Aires has been asked by the Secretary of the Chamber of Industry and Commerce to study the question of establishing in the country paper factories utilizing national raw materials. A commission has been nominated which is going to the mountain region of Neuquen y Rio Negro where the genus *Nothofagus* grows, in order to study whether that species can be used for pulp manufacture.

In addition, this Commission will visit other zones in Argentina in order to make a survey of the forestry species from which pulp products can be manufactured, the costs for labor, transport of the wood, and the manufactured products, and the possible location for one or several factories in that region.

In the five-year plan it is proposed to arrive in 1951 at the production of 50,000 tons of newsprint.

Czechoslovakia

For some time past the Czechoslovak Government has been carrying out plans for the industrialization of Slovakia where labor and other conditions are favorable for the extension of existing industries. The timber industry has not been overlooked and in the development of the timber works and sawmills, work has recently been started on the building and equipping of the following large new concerns. At Vranov, in Eastern Slovakia, a new mill will produce parquet flooring, casks, veneer, plywood, as well as chemical cellulose and other cellulose products. This mill will use only broad-leaved species for raw material. The second new concern is a large and modern sawmill being erected at Banska Bystrica in Central Slovakia. It is being built to a Swedish design and will be equipped with Swedish machinery at a total cost of about £1,250,000. The annual capacity is estimated to reach 99 thousand m³ (r) (3,500,000 cu. ft.) of round timber. At Banska will also be built a separate factory for the production of wood-wool boards and other material. Other sawmills are also being contemplated. It is expected as a result of these developments that the total annual sales of Slovakian timber and timber products will increase from the present 5 million pounds to about 18 million pounds sterling.

Norway

The Forestry Research Commission whose work has been at a standstill since the beginning of the war has been once again appointed by the Ministry of Agriculture. It has been enlarged owing to the inclusion of representatives for the industry and workers. The Commission is appointed for a period of 5 years from 1 July 1947 and consists of: Director of the Norwegian Forest Experimental Department, Professor Erling Eide (Chairman), Hans R. Borch as representative for the Norwegian Forest Owners Association, H. H. Heiberg, as representative for the Norwegian Agricultural College, Nils N. Ihlen as representative for the Norwegian Forestry Association, Hans Th. Kiaer as representative for the industry, Klaus Kjelsrud as representative for the Forestry and Agricultural Workers Trade Union, Anton Smitt as representative for the Forestry Experimental Station on the West Coast, and K. Soerhuus as representative for the Ministry of Agriculture.

Poland

Plans of the State-owned forests of Poland anticipate for 1948 the afforestation of 97,500 acres (39,500 ha.) of land, an extension of the existing timber industry, and an increase in production. With regard to lumber production, it is anticipated that 9 new sawmills will be built and 68 reconstructed or modernized. Factories will be established near bigger sawmills for the manufacture of boxes, barrels, furniture, and parquet flooring and for fuelwood from sawmill waste.

Union of South Africa

One of South Africa's industries now engaged on a big propaganda drive is the timber industry. It is not generally known that the Union is capable of producing high-grade timber. Meanwhile the Union has to purchase a considerable quantity of its timber from overseas. About 17 months ago the Forestry Department decided to launch a plan for increasing native timber supplies of softwoods required for house-building and many other industries. The aim is to make the Union self-supporting up to 90 percent of its needs in the next half-century. It is intended to establish 35,000 acres (14,000 ha.) a year, but this objective will not be reached immediately. In the private field, the South African Lumber Millers and Shook Manufacturers' Association is planning the educative campaign. Had it not been for the relatively small supply of Union timber available during the war, the country would have been almost without any timber, for imports dried up altogether. Timber for various war needs was produced in the country. One of the most important steps taken by the Association is the decision to work together with the Forestry Department and South African Bureau of Standards. South African lumber is now graded according to the severe tests laid down by the Bureau. The following facts concerning the South African lumber industry will possibly be interesting: About 5,000,000 pine trees were felled last year for the building and packaging industries; 25,000,000 cu. ft. (708,000 m³) of round logs were sawn into timber; more than 60,000,000 wooden boxes were made from South African grown timber. Among the industries wholly or partially dependent on sufficient supplies of boxes for the distribution of their products are fruit, liquor, explosives and chemicals, soap and candles, biscuits, polishes, sauces, and oils. The lumber industry employs more than 11,000 people and pays wages exceeding £800,000 a year. The mechanical and physical properties of pine grown in South Africa are somewhat superior to those of imported timber, according to tests carried out at the Forest Products Institute in Pretoria. A very large quantity of local timber is now required for the building industries and more will be needed as facilities improve for raising the pace of the postwar building program.

United Kingdom

The U.K. Timber Control has recently issued licenses for the importation of varying quantities of no fewer than 26 species of wood from East Africa, which shows the possibilities opened up by the future development of these territories. The development of timber resources, however, is a slow process, involving the use of much equipment in the form of tractors, Caterpillars, sawmill equipment, and other items which are in short world supply, but the Timber Control has received the greatest encouragement from the Government in its efforts to stimulate such supplies.

UNITED STATES OF AMERICA

Control has come back into force since 1 March on exports of United States softwoods and hardwoods to a number of countries.

Thus, the licensing system has been resumed for continental European countries, Great Britain and Ireland, Iceland, Turkey, the U.S.S.R., Portugal including the Azores and Madeira, Tangier, Spain and Spanish possessions, and the Mediterranean islands.

Until further orders, no license is needed for exports to Canada and countries in Central and South America, a fact which leaves to some traders in Latin America the possibility of re-exporting U.S. timber, as they did during the war, to countries coming under the new regulations.

This action was taken by the U. S. Government in order that timber, an essential raw material, may be provided to those countries which need it most and to limit exports which would not be of a nature to contribute to universal reconstruction.

Book Reviews

Woodflour. W. S. Dahl 119 pp. 21 shillings. The Mercury Press, Northampton, England. 1948.

Mr. Dahl, who has long been connected with the timber trade and woodflour marketing in England, has prepared a well-illustrated and instructive book dealing with woodflour, its manufacture and uses. He draws attention to the fact that a large percentage of the world's production of wood is wasted in manufacturing processes, and he pleads for a more complete utilization through wider and more efficient use of wood waste for fuel and through the manufacture of many products which can use sawdust and other wood waste as a basic raw material. There is also a chapter on lignin plastics and a note on the use of lignin as a reinforcing agent in natural or synthetic rubber.

There are a few inaccuracies, such as the comparison of a ton of sawdust and other waste with a ton of coal as fuel when referring to transport economy, and the reference to balsa as a "fungus wood." However, the description of woodflour manufacturing processes and of the wide variety of uses to which sawdust and woodflour are put is obviously the result of a close study of all phases of the production and utilization of woodflour.

An Outline of General Forestry (Third Edition, revised and enlarged, 1939, reprinted 1947). Joseph S. Illick. 297 pp. $1.25. Barnes and Noble, Inc., New York.

Professor Joseph S. Illick published the third edition of *An Outline of General Forestry*, revised and enlarged in order to follow the rapid development of ideas pertaining to forests and wood, as a general introduction to the sciences and techniques of forestry and the various branches of the conservation of natural resources which are closely allied therewith. Originally intended for students, this small book is of general interest to all persons concerned with forests and the problems of administration and management which they raise, with forest products, and the relationship of forests to the general economy of a country, of a region and of the globe. Although forest problems are studied with special reference to the United States, those of other countries are not overlooked, and the silvicultural trends and methods for the utilization of wood, both from a general standpoint and with respect to their various branches, are analyzed briefly but concretely and clearly. Numerous references appear at the end of each chapter.

La moderna tecnica delle costruzioni in legno. (The Modern Technique of Construction in Wood.) Dr. Ing. Guglielmo Giordano. 345 pp. + xv. Graphs and drawings published under separate cover as a supplement to accompany the book, 64 pp., 1,500 lire, including supplement. Editore Hoepli, Milan, Italy. 1947.

This excellent synthesis of mechanical wood utilization is not only the first important work on this subject in the Italian language, but also represents, for technicians of all countries, a practical, complete, and well-documented handbook.

The author deals first with the mechanical characteristics of wood (elasticity, resistance to compression, tensile strength, static bending, resistance to diverse dynamic stress, fatigue, wear, hardness, etc.). He continues with the grading of structural timber in each important class of stress, of the methods and processes of assemblage, and concludes the first part of the book by demonstrating the advantages of wood as a construction material.

The later chapters of the book deal with building materials derived from wood (plywood, laminated wood, sandwich, impregnated, and wallboard), then describes building codes, the characteristics of the main Italian species, and the standards for physical and mechanical tests.

The work is completed by a separate booklet containing 60 diagrams on different mechanical characteristics and 26 diagrams on different types of construction in wood.

Proceedings of the Society of American Foresters' Meeting, Minneapolis, 1947. 507 pp. + iv. $3.00. Society of American Foresters, Washington. 1948.

The complexities, problems, debates, and progress of American forestry are reflected in two annual publications. One is the *Report of the Chief of the Forest Service*, already reviewed in UNASYLVA (Vol. II, No. 3, p. 155). The other is the *Proceedings of the Society of American Foresters*. Here, through the technical papers and reports of standing committees, a live and up-to-date cross-section is to be expected. Indeed, the partition of the whole field of forestry into divisions, each with its own set of papers, is indicative of the many-sided nature, employment, and interests of the Society and of its membership.

Ten divisions are listed: Education, Forest Economics, Forest Products, Forest Recreation, Forest Wildlife Management, Private Forestry, Range Management, Silviculture, Private Forestry in the Lake States, and Progress in Lake States Forestry. The number of papers ranges from 4 to 12 in the divisions, with a total of over 80.

The speakers included both seniors who have long contributed to American forestry and younger men who have produced results worth reporting. Both questions of policy and of reporting scientific progress are encompassed in the program.

The Division of Forest Economics included the paper on forest resource valuation by Bernard Frank, already published in UNASYLVA (Vol. II, No. 2, p. 55). It also included M. A. Huberman's report on "FAO and the World Wood Shortage," the most significant paper of the meeting in the field of international forestry.

The Society has done a useful job in making the proceedings readily available to all who wish to follow the always diverse, commonly controversial, and invariably interesting developments in American forestry.

Personalities

The very well-known professor, Agnar Barth, died 4 May 1948. He was one of the leading authorities on forestry in Norway. He was born in 1871 and in 1899 he started teaching forest taxation at the Agricultural College in Aas, Norway. From 1931 to 1943 he was Professor in Silviculture and Dean at the same college. He wrote textbooks and numerous articles for technical periodicals and was always active in the discussion of Norwegian forestry problems.

Arthur Koehler, widely known scientist and authority on wood structure and identification at the U. S. Forest Products Laboratory, Madison, Wisconsin, retired on 30 June 1948. A member of the staff since 1914, Mr. Koehler has been chief of the Laboratory's Division of Silvicultural Relations He will be succeeded by Benson H. Paul, who has been on the laboratory staff since 1922.

After almost twenty years at the Princes Risborough Forest Products Research Laboratory, Mr. E. H. Nevard is taking up a responsible position in the commercial world. While at the Laboratory he carried out research which led to stress grading of Baltic redwood and followed this with preliminary work on the strength of joints—a corollary of stress grading. During the past two years, Mr. Nevard has been in the external relations section of the laboratory investigating trade problems, lecturing to architects, engineers, and students, and answering the many enquiries sent to the laboratory. In his new appointment as Technical Liaison Officer with the manufacturers of Wolman Salts, Mr. Nevard will be advocating the efficient use of timber which can be effected not only by reducing dimensions in accordance with stress grading but also by increasing its useful life by adequate preservation.

The Forestry Commissioners announce that Mr. W. L. Taylor, C.B.E., will relinquish, at the end of June, the appointment of Director-General, Forestry Commission. He will be succeeded by Mr. A. H. Gosling, who is at present Deputy Director-General. Mr. Taylor will continue to serve as a Forestry Commissioner, and for the present will devote the whole of his time to the work of the Commission. Mr. W. H. Guillebaud, the Commission's Director of Research and Education, will succeed Mr. Gosling as Deputy Director-General. In turn, Mr. James MacDonald, a Conservator of Forests on the Staff of the Director of Forests for Scotland, will become Director of Research and Education.

The Turkish Government has officially asked Professor Manfred Naslund, Chief of the Swedish Institute of Experimental Forestry, to organize a Forestry Experimental Institute in Turkey similar to that in Sweden.

Meetings and Conventions

In May 1948 a *conference of agricultural and forestry workers* was held in Prague with the following countries participating: Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Rumania, U.S S.R., and Yugoslavia. The conference was organized by the Institute for International Collaboration in Agriculture and Silviculture, located in Prague.

This conference adopted a large number of resolutions which have a bearing both on silviculture and agriculture and which may be classified as follows:

1) General program of action of the Institute for International Collaboration in Agriculture and Silviculture.
2) Problems of co-operative movements, statistical control of the implementation of agricultural plans, organizing and planning forestry economy and wood industries.
3) Methodology of research and controls. Exchange of experiments and pest control and control of agricultural plant diseases and forest tree diseases.
4) Theoretical and practical education. Setting up centers of practical training for qualified forestry workers.
5) Publications, radio broadcasts, films on agricultural and silvicultural subjects. Expansion of publications issued by the Institute: *Interagra* and the Bulletin of the Institute.

The annual meeting of the Association of Finnish Sawmillmen was held in Helsinki on 6 April.

The opening speech was given by Professor M. Levon, Chairman, who stressed the importance of co-operation between the technical organizations in the timber industry.

An interesting event was the motion picture and lecture on British timber economy presented by Mr. Grugeon, technical timber expert of Messrs. Price and Pierce, London.

Mr. E. A. Jussila gave an account of the work of the committee appointed for the purpose of handling matters relating to sorting of planed goods.

Immediately after the meeting, a session of the Board was held. The Secretary, Mr. Kinnunen, wished to retire after having held the position for many years, and Mr. U. Rintakoski was elected general secretary, while Mr. K. Kivimaa was re-elected technical secretary. An executive committee was elected, consisting of Professor Levon, Mr. Kinnunen, Mr. Ojala, Mr. Vesa, and the two secretaries.

At the general *Forest Week* meeting in Stockholm on 8 March, Professor Manfred Naslund, Director of the Government Forest Research Institute, read a most interesting and instructive paper on "The Condition of our Forests and the Means of Increasing their Productivity."

Professor Naslund's paper was based on the results so far obtained in a comparison of the first general survey of the Swedish forests in 1923-1929 with the second, which has been going on since 1938 and has, to date, covered 75 percent of the forested area of Sweden.

The speaker said that the second survey had shown that the timber resources, while diminishing in the northern parts of the country and increasing in the south, had increased for the whole of Sweden by about 5 percent.

In order to make the future yield of the forests satisfactory, their stands of timber must be increased, and the only way of doing this is to cut less than the annual increment for some time to come and to secure the maximum possible new growth in present and future regeneration areas.

Calculations made at the Forest Research Institute indicate that the amount of merchantable timber—sawlogs and pulpwood—cut in upper and central Norrland ought to be reduced for a considerable time to come by no less than 30 percent compared with the annual cuts from 1936 to 1939. The general result of the calculations is that the total annual cut in the whole country must be reduced by about 5 percent compared with the period 1936 to 1939.

The first *Inter-American Conference on the Conservation of Renewable Natural Resources*, organized by the Pan American Union, will be held at Denver, Colorado, from 7 September to 20 September 1948. The statement which precedes the agenda of the conference stresses the close relationship which exists between renewable resources and the urgent need for remedying a tragic situation: "World populations have now increased until there are only about two acres—less than one hectare—of productive land for each individual and, while the destructive practices mentioned above are daily causing these two acres to shrink, populations are mounting at the rate of about 50,000 people per day." The agenda is divided into six sections: Section I—Human populations and productive capacity of the land; Section II—Renewable resources and international relations; Section III—Land use and the social sciences; Section IV—The dynamics of renewable resources; Section V—Education in conservation dynamics; Section VI—Making conservation effective.

A *conference on the utilization and chemistry of bark* will be held 17 September at the Massachusetts Institute of Technology, Boston, under the auspices of the Northeastern Wood Utilization Council. Developments in bark utilization from pulp and paper mills, as well as from sawmills and lumbering operations, will be reviewed.

The *United Nations Conference on Freedom of Information* which met at the European Headquarters of the United Nations, Geneva, Switzerland, during the period from 23 March to 21 April, 1948, included the following recommendation in its final report:

> The United Nations Conference on Freedom of Information
>
> Draws the attention of the Economic and Social Council to the harm and dangers which inadequate production of newsprint, and unequal distribution thereof, have on the exercise of freedom of information,
>
> Recommends that the Economic and Social Council consider as soon as possible, in the light of the enquiries carried out by the Council and by UNESCO, practical measures to remedy the situation; and
>
> Recommends that governments give their support to the UNESCO plan for aid to war-devastated countries; and
>
> Invites UNESCO to extend such aid to other countries suffering from an acute shortage of newsprint.

In sixteen European countries surveyed, wartime loss of housing amounted to the equivalent of four and a half million dwellings. In the two and a half years since the end of the war, only 750,000 dwelling units were repaired or newly built — the equivalent of about one year's building activity before the war.

In order to make up for the remaining war damage and to satisfy the need for over eight million units created by the lack of building during the war, a construction effort equal to eleven years of building at the prewar rate would be required.

These telling figures about Europe's housing plight were given by the Housing Subcommittee of the Economic Commission for Europe, which met in Geneva from 13-15 May.

With the rate of building only about one third that which the countries themselves have declared necessary, the Subcommittee described the building industry as one of the most backward in technology, design, and organization. Members charged that the gap between needs and supply is being widened. It suggested mechanization of the industry based on better design, which would give more homes at less cost.

The Subcommittee laid emphasis on the shortage of basic building materials, such as timber and steel, materials which are also required in much larger quantities than now available by other industries essential to the reconstruction of Europe.

Recognizing the many problems facing European housing, the Subcommittee established two working parties; one on programs and resources and the other on technical problems. The Subcommittee realized that more building materials must be produced and that more houses must be built with less materials.

The Working Party on Programs and Resources will give priority to the initiation of measures to promote exchanges of finished building materials and of equipment for producing such materials. It was recognized that comparatively small investments for equipment in certain countries should be able to yield considerable quantities of essential building materials.

The Working Party on Technical Building Problems will seek to promote economies through the rationalization of conventional construction methods. Provision has therefore been made for an exchange, among interested countries, of information on methods to save building materials, manpower, and time, and on possible suitable substitutions for materials which are scarce.

Three reports constituting the first general survey of the European housing situation are to be combined into a single report, which will be expanded and later in the year made available to all governments and to organizations and persons interested in the housing field.

Delegations from the following countries participated in this first session of the Subcommittee: Austria, Belgium, France, Greece, Italy, Ireland, Poland, the Netherlands, Sweden, Switzerland, Czechoslovakia, the United Kingdom, the United States of America, and Yugoslavia. Observers were present from FAO and WHO.

THE Nations accepting this Constitution, being determined to promote the common welfare by furthering separate and collective action on their part for the purposes of

raising levels of nutrition and standards of living of the peoples under their respective jurisdictions,

securing improvements in the efficiency of the production and distribution of all food and agricultural products,

bettering the condition of rural populations,

and thus contributing toward an expanding world economy,

hereby establish the Food and Agriculture Organization of the United Nations . . . through which the Members will report to one another on the measures taken and the progress achieved in the fields of action set forth above.

—Preamble to the Constitution of the Food and Agriculture Organization of the United Nations

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